

UNCLASSIFIED

AD NUMBER

AD366697

CLASSIFICATION CHANGES

TO: unclassified

FROM: confidential

LIMITATION CHANGES

TO:

Approved for public release, distribution unlimited

FROM:

Notice: Release only to U. S. Government Agencies is authorized. Other certified requesters shall obtain release approval from Director, Defense Atomic Support Agency, Washington, D. C. 20301.

AUTHORITY

DSWA ltr., 4 Apr 97; DSWA ltr., 4 Apr 97

THIS PAGE IS UNCLASSIFIED

XRD-5

100-15-2944

(14) XRD-5

CONFIDENTIAL

① BUREAU OF SHIPS GROUP
TECHNICAL INSPECTION REPORT

36697

copy

(6) OPERATION CROSSROADS.

FAILURES OF MASTS, YARDARMS,
BOOMS AND RIGGING [U.]

(8)

U. S. GOVERNMENT PRINTING OFFICE: 1947. THIS REPORT DIRECTLY
FROM DDC. OTHER INFORMATION WILL BE REQUESTED THROUGH

Division
Defense Atomic Support Agency,
Washington, D. C. 20301

(11) 1947,

(12) 11 p.

~~OPERATION CROSSROADS~~

~~DIRECTOR OF SHIP MATERIAL~~

JOINT TASK FORCE ON

CONFIDENTIAL

REG. NO. 4

Downloaded at 12:00 PM
Not authorized for
GROUP 3
classification
JAN 1965

2

CONFIDENTIAL

BUREAU OF SHIPS GROUP
TECHNICAL INSPECTION REPORT

U. S. GOVERNMENT PRINTING OFFICE: 1964 O - 348-000
FROM DDC. OFFICE OF THE DIRECTOR, BUREAU OF SHIPS GROUP

Director
Naval Atomic Support Agency
Washington, D. C. 20301

FAILURES OF MASTS, YARDARMS, BOOMS, AND RIGGING

CONFIDENTIAL

"This document contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, Title 18, U. S. C., Section 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law."

Approved:

F. X. Forest,
Captain, U.S.N.

B. B. Elliott,
Principal Naval Architect
(P-6)

CONFIDENTIAL

Page 1 of 211 Pages

GROUP 3 1 JAN 1965
Downgraded at 12 year intervals;
Not automatically declassified.

CONFIDENTIAL

CONFIDENTIAL

TABLE OF CONTENTS

	Page No.
General (Section I) - - - - -	3
Details of Damage (Section II) - - - - -	4
Conclusions and Recommendations (Section III) - - - - -	19
Photographic Section (Section IV) - - - - -	21

~~CONFIDENTIAL~~
EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION
EXEMPT FROM RESERVATION OF RIGHTS ACT
USE MILITARY CLASSIFICATION SAFEGUARDS

CONFIDENTIAL

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

SECTION I - GENERAL

1. There was no significant damage to masts, yardarms, booms and rigging for Test B; therefore, the following discussion is confined to the results of Test A.

2. The purpose of this report is to record factual data obtained in the field on failures of masts, booms, yardarms and rigging. A discussion of the characteristics of the blast wave which acted on the masts and other items is contained in the overall report on superstructures and should be studied before any analysis of the material contained herein is attempted.

3. The ships covered by this report are: ARKANSAS, NEVADA, INDEPENDENCE, PENSACOLA, SALT LAKE CITY, PRINZ EUGEN, SAKAWA, RALPH TALBOT, RHIND, HUGHES, CRITTENDEN, DAWSON, BRJLE, and the submarine SKATE. No other failures occurred affecting the subject matter of this report.

4. The ex-Japanese battleship NAGATO was within the radius damage to masts, etc., but due to her heavy construction no effect was apparent. She is therefore not discussed herein. A general discussion of the pagoda construction is included under the miscellaneous section of her Test A report.

5. A short general discussion of each ship, with reference to pertinent photographs, follows. In general, the material has been included in the staff report of the individual ship but is collected here for completeness. The ships are discussed in order of increasing distance from the burst. In a later section, damage will be tabulated against distance and pressure, and suggestions will be made for study in connection with future design.

TOP SECRET

Page 3 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

SECTION II - DETAILS OF DAMAGE

A. SKATE (SS305).

1. The periscope and radar shears are bent about 15 degrees and 25 degrees, respectively, to starboard. The bolted joint between the periscope foundation and shears failed, permitting the shears to be pushed to starboard to an angle of about 15 degrees. The periscope tubes bent. The failure was in the studs and bolts; about 50 % of which failed in tension and the remainder of which failed in bending or by stripping of the male threads.

2. The foundation for the SS radar mast was distorted. The port 6 x 6 H-beam leading down and aft to the hull is buckled in a smooth curve forward and to starboard, with maximum deflection of 3 inches about mid-length. The toe bracket on the inboard side of the port beam at the hull shows compression failure due to panel instability. The starboard H-beam shows compression failure of the same type in the region 2 to 8 inches above the hull. The deformation in the port leg apparently was caused by contact with other structure. The starboard leg failed due to the blast pushing the after end of the upper part of the foundation to starboard. The angle forming the horizontal strut between the two legs is parted from the starboard leg at the weld. The upper part of the radar mast foundation consists of a 20 pound plate in the shape of a hollow square. The after end of this square was hit by the antennae trunk and moved to starboard about 4 inches, distorting the geometry of the section. The radar mast shears is undamaged except that it failed at its base just above the weld between the plating and the lower flange. This failure permitted the mast and shears to be blown to starboard at an angle of about 25 degrees.

B. SAKAWA (Ex-Jap CL).

1. No observations could be made on board this ship after Test A. Photos 1832-4 and 1860-2, pages 22 and 23 show that the blast wave, which attacked the ship at about 180 degrees relative,

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

leveled all superstructure aft of the main tower. The photographs indicate that all standing structures are leaning forward; a condition which may have been caused by the failure in tension of their after supports which were weak. The collapse of the polemast on the small tripod abaft the main tower is an example of typical blast failure of small poles. It is probable that this pole would have broken and fallen to the deck had the fall not been interrupted by the forward tower structure.

C. YO 160.

1. No data was obtained from this craft, which was closer than the CRITTENDEN, because her superstructure was demolished.

D. CRITTENDEN (APA77).

1. This ship took the blast at about 350 degrees relative. Photos 196-156-27 and 28; and 227-49-114, 116, and 119; pages 24, 25, 27, 26, and 28 are comparative views taken before and after Test A. The jackstaff is bent to starboard and aft making an angle of approximately 45 degrees with the horizontal as shown in Photo 1921-11, page 29. The ensign staff is bent aft at an angle of about 45 degrees with the vertical, representing a movement of about 25 degrees. See Photo 227-49-116, page 26. The foretop mast is bent sharply aft and slightly to starboard just above the cross tree level. See photo 1903-7, page 30. It is about 80 degrees out of normal position, and is fractured at the bend. The paint is blistered along the entire length of the mast. The foretop stay carried away in the barrel of the turnbuckle leaving 2 stays in place on each side of the mast. See photos 2086-9, 2101-9 and 2101-12; pages 31, 32, and 33. The port and starboard cargo booms, stowed in clamps along the mast are bent sharply, but less than the mast, at the crosstree level. The bend occurs just beyond the middle section of the booms and has damaged them beyond repair. The main body of both forward cargo booms was given considerable protection by the foremast.

2. The signal polemast on the forward stack is bent slightly aft just above the bracket by which it is secured to the stack. See

TOP SECRET

Page 5 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

photos 1904-7, 2058-9, and 1922-8; pages 34 , 35 ,and 36 . Just above the braces, at mid-height, the mast bends sharply aft and slightly to starboard. The braces are sharply bowed. The port yardarm bends sharply at the mast and extends somewhat to starboard. The starboard yardarm is broken off about six inches from the mast.

3. The maintopmast is bent about 110 degrees out of its normal vertical position and in the direction of the blast travel. See photos 227-49-116, 1906-9, 1906-12 and 1921-12; pages 26 , 37, 38 , and 39 . The bend occurs just above the crosstree level and, as in the case of the foremast, the mast is fractured at the bend. The mainmast cargo booms, which were stowed in clamps along the mast, are useless due to their severe deformation. Photos 1922-2 and 1905-11; pages 40 and 41 show severe kinking of the starboard boom about 10 feet above the hinge pin. The port boom is bent in an easy curve.

4. Standing rigging is in disarray from failure of the topmasts but is intact generally, although several of the stack stays failed in the turnbuckles. Photo 1906-8, page 42 shows several items of rigging with wires and end fittings intact.

5. Photo 1960-12, page 43 shows the port boat boom, frame 59, swinging free. This boat was clamped in place before the test. The starboard boat booms remained in place. The pipe life rails on the port side are generally damaged, and on the upper deck forward, port side, there are large gaps in the rail. The rails on the upper deck suffered more severely than did those on other levels.

6. All boat davits, except the starboard forward unit, are inoperable. Photos 1922-3, 4, 6 and 7; pages 44 , 45 , 46 , and 47. are views of the port after davit, which is the most severely damaged. The davit arms are the most vulnerable part of the davit as the large area of the arm, when under attack by high pressures, tends to pull the roller out of the track as is shown in the photographs. The roller is completely out of the forward arm of the after pair, and the after arm and davit are distorted.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

E. ARKANSAS (BB33).

1. Photos 196-166-30, 33, 34, and 227-91-40, 42 and 45; pages 48, 49, 50, 51, 52, and 53 inclusive; are for comparative purposes. All life lines, which were not protected by structure, were blown away. Life line stanchions are distorted and about half are missing. The jack staff, beginning about 6 feet above the deck, is bent about 30 degrees out of the vertical and in the direction of the blast wave, which was about 135 degrees relative. The 8 inch diameter SG radar pole mast collapsed about 4 feet above the main radar platform, and is bent forward and about 45 degrees to port. The change in vertical position is about 100 degrees, so that the pole rests on the port side of the 5 inch diameter pipe yard arm at the SK radar platform level. There is no discernible fracture in the pole. The port yardarm is bent and distorted as a result of the pole mast having hit it, and the yardarm clamps loosened allowing the arm to slide about 6 inches to port. The marked bend of the pole is due to the inability of the collapsed pipe section to support the offset weight which resulted from the initial bending caused by the blast. The starboard wing of the SK radar plot frame is bent up about 40 degrees from normal. The overhead of the director station at the 07 level is supported by pilasters, all of which were bent in the direction of the blast. The 15 inch pole mast, which supports this director station, is bent smoothly in a direction of about 300 degrees relative and about 20 degrees out of the vertical. Photos 2091-3, 2094-1, and 3; pages 54, 55, and 56 are views of the conditions in this area. The photographs show the rigging is still connected. Below the 06 level, there are two areas of damage to the foremast tripod, both of which are just below the rangefinder platform, one port and one starboard. Here, as shown in photos 2094-7, 8, 9, 10; 1783-1, 2 and 2135-3; pages 57, 58, 59, 60, 61, 62, and 63, the blast wave acted on the overhang of the platform with sufficient force to pull these brackets out of the tripod legs. There is no perceptible deformation of the tripod legs. No damage to the deck connections at the foot of the legs or to any of the tripod supports is observable.

2. The port boat crane is operable but the starboard crane is inoperable. The crane structure is bent about 5 degrees out of

TOP SECRET

Page 7 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

normal. The blast blew all of the life lines and most of the stanchions overside and distorted the remaining stanchions. The boat boom at frame 42, starboard side, is usable. The entire mainmast structure is bent forward and to port as the result of failure of 1 7/8 inch tap rivets connecting the base of starboard leg to the second deck. The riveted connection of this leg at the main deck also failed. The starboard leg is about 11 inches above the second deck as shown in photo 2146-5, page 64 and has lifted about 6 1/2 inches above its normal position at the main deck. See photo 2146-1, page 65 . Photo 2146-6, page 66 shows the distortion and cracking of the main deck beam at frame 103 in way of the starboard leg. See also Photo 2146-7, page 67 . The effect of these failures is reflected in accompanying failures in the port after leg of the tripod and in the forward leg. Photo 2111-10, page 68 shows a slight wrinkle in the port leg due to compression. Photos 2134-7 and 2111-9, pages 69 and 70 are additional views of this leg. The deformation shown in these photographs is about 8 feet above the main deck just above the wrapper plate. The forward leg has a compound wrinkle in the port forward sector just above the wrapper plate, and about 4 feet above the deck. The amplitude of the wrinkle is about 4 inches. In way of the wrinkle, the seam of the mast has opened slightly on the port side, forward, about 30 degrees off centerline. See photos 2111-7, 2111-8 and 2134-8; page 71, 72 and 73. The main deck connection to the forward leg shows cracking all around. The excess loading on this leg has been passed into the supporting structure below. Photos 2146-9 and 2146-10, pages 74 and 75 show the slight paint cracking around the leg, under the second deck. Photo 2146-12, page 76 shows a 3 inch dish in the centerline engine room bulkhead frames 99 - 100. This dish is about 3 1/2 feet long. Photo 2147-1, page 77 is taken on the opposite side of this bulkhead and one frame space forward.

3. There is some tipping of the structure about the 01 level as can be seen in upper left photo 2111-9, page 70 . Note buckle in plating of 01 level. Photos 1783-3 and 1783-4, pages 78 and 79 are further evidence of this tipping. Note tear in plating in photo 1783-4, page 79 and separated weld in photo 1783-3, page 78 See also photo 2111-11, page 80 . The entire structure has been cracked as evidenced by photo 2146-3, page 81 showing a buckle

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

on the 01 level in way of the starboard and 2146-2, page 82 showing a crack in the weld at the 02 level around the leg.

4. The main topmast fell forward and hung top down by cables. The topmast was supported on an extension of the director platform as shown in photos 1895-7 and 2135-7, pages 83 and 84. The foot of the mast was welded to a 10 inch base plate which was welded to the platform. The weld between the base plate and platform fractured. The forestay parted about 8 feet above the main deck, the starboard after stay about 12 feet above the deck, and the port after stay near the top of the mast. The starboard yardarm bent sharply about 3 feet from the mast due to the restraining influence of a guy. The bend in the mast was caused by the head of the mast striking the deck, not by the blast. See photos 1895-9, 1895-6, 1895-10, and 1775-12; and 1895-8; page 86, 88, 89, 85, and 87.

F. NEVADA (BB36).

1. The forward tripod of the NEVADA was about 600 yards from the burst, which bore about 210 degrees relative. Photos 196-151-10, 15, 9; 227-91-75, 74 and 73; pages 90, 92, 94, 91, 93, and 95 are comparative views taken before and after Test A. The SG radar polemast is broken and lying on the radar platforms. The 15 inches diameter polemast supporting the radar platform is bent forward about 15 degrees and practically in the centerline plane of the ship. The after half of the pole has a slight but definite horizontal wrinkle, about 30 inches above the main battery control platform. The port signal yardarm is twisted and bent and the starboard yardarm broken off as the result of failure of the connections. See photo 1909-1, page 96 for general view of foremast and mainmast yardarms. Note the absence of starboard forward arm. The male bracket at the starboard after side of the foremast structure is intact. The female end of the yardarm spread as is clearly visible in photo 1900-3, page 97. Indications are that the connection bolt failed. At the forward connection, both the bracket and bolt remained intact but the male bracket pulled out of its fillet weld to the mast structure. The yardarm was blown forward and to starboard as shown in photo 1900-4, page 98.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

The foremast tripod appears to be in good condition. There is no discernible damage to the legs above the superstructure deck except a small, almost imperceptible crack at the bottom of the port leg of the tripod. The crack is shown in photo 2137-9, page 99 and the leg in 1900-6, page 100. Photos 2137-12 and 2154-3, pages 101 and 102 show crippling of superstructure deck longitudinals against the port and starboard legs of the main forward tripod. This is considered to be failure due to the blast pressure on superstructure deck and not to movement of the legs.

2. At frame 73 the starboard after leg of the starboard 40mm director tub tripod has pulled the superstructure deck upwards about 3 inches. The forward leg of both the port and starboard director tubs tripods are wrinkled through about 270 degrees, approximately 2 inches under the superstructure deck. Beams in these areas are twisted and buckled due to blast pressure on the deck plus tipping of the director tripods. See photos 2137-8, 10, 11, 2154-1, 2, 4, 5, 6, and 8; pages 103, 104, 105, 106, 107, 108, 109, 110 and 111.

3. The main topmast pole was blown forward and to starboard, by the blast, with such force that the mast section collapsed about 18 inches above the top of after main director station and broke at that point. The pole mast is about 10 1/2 inch O.D. with about 1/2 inch wall thickness. Luders lines are visible above and below the fracture which shows crystalline structure. This pole is shown in photos 1900-1, 2, 1897-10, and 1897-11; pages 112, 113, 114, and 115. Photo 1900-7, page 116 shows the fracture in the pole and 1900-8, page, 117 the fracture in the stub. The port and starboard yardarm are both bent forward and the port arm is severely bent upward. Although the legs of the tripod show no discernible damage they carried considerable load, as shown by a slight crippling of bulkhead 76 1/2 under the superstructure deck. No other signs of damage are discernible.

4. Jackstaff, handrails up to 2 1/2 in diameter, lifelines, and davits are generally bent where exposed to the blast wave, although exceptions occur as shown in photo 1889-8, page 118.

TOP SECRET

Page 10 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

5. The boat boom, which was service rigged, was blown into the position shown in photos 1889-7 and 1900-5, pages 119 and 120. Kingpost and struts at frame 86 are uninjured. The male fitting at lower end of boom is bent as shown in photo 1889-5, page 121. The stern crane is completely crippled. See photos 1889-9, 10, 12, and 1909-4; pages 122, 123, 124 and 125.

G. INDEPENDENCE (CVL22).

1. Mast, signal and other platforms on the island structure were carried away. Radio whip antennae, pole, and SK radar stool on the starboard side were carried away. Four radio poles on the port side, gallery level, outboard of flight deck, were curved away as were life lines on the port side.

2. The airplane crane, frame 48, starboard side, is dislodged from its roller race.

H. PENSACOLA (CA24).

1. PENSACOLA took the blast from about 169 degrees relative. Photos 196-154-1, 227-93-45, 227-50-126 and 127; pages 126, 127, 128 and 129 are comparative views before and after Test A. SG radar pole mast is bent forward in a smooth curve such that a tangent to the curve at the top of pole would be at an angle of approximately 60 degrees with the vertical. The pole is bent about 100 degrees to port of the centerline plane. The port and starboard yardarms are angled slightly forward of the normal plane. There are no fractures in the pole or yardarms.

2. Photos 1757-1, 2; 1761-12; 157-8; and 1759-8 pages 130, 131, 132, 133 and 134 are views of the foremast. Photos 157-8 and 1759-8, pages 133 and 134 show that the pole which supports the radar platform is bent in a smooth curve starting about 12 feet above the fire control platform at a point just above the 4 inch pipe braces. There is no failure in these braces or in those between the pole and the radar platform. Failure of these poles is the result of bending under load without evidence of local weakness.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

3. The forward tripod shows no failures and there are no apparent failures in the supports under the after legs. However, the blast acted on the structure with sufficient force and in such a direction that practically all of the tipping movement was resisted by the supports under the foreleg which were damaged as a result. Photos 1762-2, 3; 1763-5 and 6; pages 135, 136, 137 and 138 are views of bulkhead 42 under the 1st platform. The foreleg rests on the 1st platform directly over this bulkhead. As shown in Photo 1762-2, pages 135 the 12 1/2 pound bulkhead plate buckled aft about 15 inches below the 1st platform and horizontally between vertical channel stiffeners. The buckle in the bulkhead plate is about 1 1/2 inches deep. The flanges of channel stiffeners are buckled about 8 inches below the toes of brackets or about 30 inches below the deck.

4. Lifeline stanchions and guard rails are distorted or broken where located in direct path of the blast. See photo 1761-12, 1759-4, 1968-7, 1755-10 and 1759-7; pages 132, 139, 140, 141, and 142. Where they are protected the stanchions and lines are generally carried away or burned. Wire stays generally remained intact but loose. Davits are operable. The starboard stack stays parted. Those on the port side were intact but loose.

5. The mainmast was deflected forward approximately 2 feet by the blast. Most of the deflection took place above the junction of the mast and the struts, which is about 20 feet above the superstructure deck. See photos 1759-4, 1968-7, 1755-9, 1757-11 and 1761-3; pages 139, 140, 143, 144 and 145. The struts pulled up the superstructure deck plating due to tipping of the mast by the blast. The misalignment was 1 1/2 inches port and about 3 1/2 inches starboard where the deck plating is torn. See photos 2161-5, 2161-6 and 155-5; pages 146, 147, and 148. Photos 2161-7, 1757-6 and 7; pages 149, 150, and 151 show the underside of the superstructure deck in way of the strut. Photo 2161-9, page 152 shows a slight buckling of the 5 pound longitudinal bulkhead just to port of centerline, main deck, frames 88 - 90, which was caused by forces from the mast above.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

I. DAWSON (APA79).

1. DAWSON was struck by the blast at about 320 degrees relative. Photos 196-156-37, and 39, and 227-87-64 and 66; pages 153, 154, 155 and 156 are comparative views before and after Test A. The jackstaff is bent to starboard and aft about 10 degrees out of vertical. The foremast is unharmed except for the truck light extension which is bent about 5 degrees. The 15 ton port cargo boom on the foremast shown in photo 2104-6, page 157 has two bends, each approximately 5 degrees. One is about 8 feet from the base and the other about 10 feet from the tip. The boom is still servicable. The starboard boom on the foremast appears to be very slightly bent.

2. The signal mast, on the forward stack, is bent slightly aft and to starboard just above the connection to the stack. It also is bent about 30 degrees out of normal above the pipe braces, which are bowed. See photo 2104-10, page 158. Yard arms are bent somewhat aft, and halyards carried away.

3. The lower section of the mainmast is intact. About one foot above the step in the mast the top section is bent about 30 degrees out of normal in the direction of travel of the blast. There is previous fracture at this point. See photos 1773-3 and 2103-1, pages 159 and 160.

4. The starboard davits show no damage and are operable. The forward port davit shows evidence of overloading. The after wire fall has about 1/2 of its strands torn between the fall block and the winch. Renewing this fall might restore the davit to service. The after port davit is partially wrecked and is out of service. The travelling arms are pushed about 60 degrees out of vertical and the strongback is out of its bearings. The wire falls are practically severed. See photo 1922-9, page 161.

5. Unless protected by intervening structure, life line stanchions and rails are bent or twisted.

6. Most antennae are down but standing rigging is intact.

TOP SECRET

Page 13 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

J. SALT LAKE CITY (CA25).

1. This ship was attacked from about 230 degrees relative. Photos 227-91-46, 47; 227-50-113, 116, 117; 196-159-10, 11, and 12; pages 168, 169, 166, 167, 165, 164, 162 and 163 are comparative views before and after Test A. The pole mast supporting the SG radar is bent in a smooth curve in the direction of blast travel. The condition of this polemast, the jackstaff and mainmast pole can be seen in photo 227-91-46, page 168. There is no discernible damage to any of the main tripod structures or their supports.

2. Photos 1861-5, and 1869-5, pages 170 and 171 are views of the forward radar polemast showing its curvature of about 20 degrees. The SG radar platform and polemast supporting it are apparently undamaged. The yardarms on the forward tripod are practically undamaged. Whip antennae bent sharply. See photo 1869-6, page 172. Rigging appears to be intact except stays to the forward stack which may be seen in 1869-3, page 173. The pole mainmast at frame 88 is bent in the blast direction in a smooth curve. The horizontal displacement of the mast head is about 20 feet, the yardarm is slightly twisted. The mainmast backstay failed in the lower shackle and the starboard yardarm stay failed just above the lowest insulator. See photos 1868-8 and 9, pages 174 and 175. The after stack fell against the starboard leg of the airplane crane tripod and bowed it about 10 degrees out of normal, as shown in photos 1868-11, 1869-4, and 1868-10; pages 176, 177 and 178. Life line stanchions were distorted and some of the lines flung on the deck. The davits are operable.

K. HUGHES (DD410).

1. The blast struck the HUGHES from about 190 degrees relative. Photos 227-513-11 and 114020; pages 179 and 180 are views before and after Test A.

2. The davits, boat booms, and jack and ensign staffs are uninjured. The torpedo crane is undamaged.

3. The foremast is bent forward about 18 degrees and about five degrees to starboard. See photo 2198-4, page 181.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

The bend is just above the mast fitting at the navigating bridge level. Paint at this point indicates that the mast was strained in tension on the after side and in compression on the forward side. See photos 2198-3 and 2198-2, pages 182 and 183. The yardarms are in good condition. The pin holding the shackles of the after guys failed in shear at the mast fitting.

4. The mainmast is broken off at the top of the tripod braces, about eight feet above top of the deckhouse.

L. BRULE (APA66).

1. BRULE was struck by the blast wave from about 140 degrees. There is no damage to either foremast or mainmast. There is minor bending of the jackstaff and stern lightpole. Both boat booms were secured before the test and the port boom suffered no damage. The starboard boat boom broke at frame 60 about four feet from the hinge and hung vertically from the stay.

2. The port life rails are generally undamaged. On the starboard side the rails are damaged but servicable on all decks. The chain life lines on the starboard side carried away between frames 42 and 60. The cable life lines on the fan tail are blown from the stanchion hooks. Approximately 60 percent of the stanchions are distorted.

3. The port and starboard davits are physically in good condition. The starboard davits are inoperable due to failure of the controller panel.

4. The port cargo booms are undamaged. The starboard cargo booms are both deflected inboard. The after 15 ton boom is deflected about 6 inches at each end of the enlarged section in the middle. The diameter at the point of deflection is about 12 inches. The forward 5 ton boom is deflected about 2 inches at relatively the same point.

TOP SECRET

Page 15 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

M. RHIND (DD404).

1. The blast struck this ship from about 60 degrees relative. The jackstaff, port boat boom, life line stanchions, and davits are in good condition. The starboard boat boom is slightly twisted.

2. Photos 196-156-1, 227-49-137, 227-283-58 and 227-520-42; pages, 184, 185, 186, and 187 are comparative views before and after Test A. In photos 227-283-58 and 227-520-42, pages 186 and 187, it appears that while the foremast and mainmast have been bent in the direction of the blast, the head of the foremast has been bent into the blast. Investigation showed that the foremast is cracked just below the yard. The position of the yardarm is relatively unchanged with respect to the upper portion of the mast which is askew to the main body of the mast. Radar on the starboard yardarm are gone but the upper stays are intact. All strand antennae are down and whip antennae are bent or broken. The main body of the foremast is about 10 degrees out of its normal position. The foremast is about 10 degrees out of its normal position. The foremast wave guide is twisted around the breakdown lights. There are bends, kinks nearly, in the foremast just above the padeyes to which the lower mast guys were secured about 12 feet above the brackets connecting the mast to the main deck. There are similar bends just at the tops of the brackets. The two 3/4 inch wire lower forward guys parted about 20 feet from the lower end. The remaining guys on this mast have approximately 14 inches slack. Photo 2200-9, page 188 shows the rigging and antennae still remaining and indicate that most of it is slack. Photo 2200-2, page 189 shows breaks in the cable guards at the navigating bridge level. Photo 2200-1, page 190 shows the frayed end in the lower portion of the starboard lower guy.

3. The mainmast is bent about 5 degrees in the direction of the blast. The bend starts about 8 feet above the top of the after deck house just above the pipe braces which support the mast. See photos 2200-7, 2200-8 and 2200-10; pages 191, 192 and 193. The sternlight pole, shown in photo 2200-11, page 194, is bent aft and to port.

4. There is no failure in below deck supports of either the foremast or mainmast.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

N. RALPH TALBOT (DD390).

1. The blast, which struck the TALBOT from about 135 degrees relative, bent the foremast about 3 degrees forward and 5 degrees to port. Photos 196-163-13 and 15, 227-513-46 and 48, and 227-243-22 and 24; pages 195, 196, 197, 198, 199 and 200 are comparative views before and after the test. The bend occurred about 20 feet from the top just above a joint in the mast where the dimensions of the mast section are reduced. This point is about 5 feet above mast fitting at the director level. Photos 2198-5 and 2198-6, pages 201 and 202 show these bends and that the yardarms are unharmed except for slight distortion of the starboard yard. Stays attached to the mast-head are intact. The starboard guy, attaching to the main deck at frame 50, came loose due to failure in sheer of the pin through to the mast fitting. The wire in the after guys, port and starboard, parted just above the turnbuckles at the attachment to the 01 level at frame 86. The remaining starboard guy is so badly stretched that it is useless.

2. There is no damage to supports under the mast. All davits, boat booms, lifeline stanchions appear undamaged. Insulators to all but the two end antennae on the yardarm broke, letting the antennae fall.

O. PRINZ EUGEN (Ex-German CA).

1. The blast, attacking this ship practically head on, caused little damage except to fore and main top masts. Photos 196-157-38 and 227-92-101, pages 203 and 204 are comparative views before and after Test A. Photos 2199-2, 3; 2200-12, 2199-1, 1773-8 and 1774-5; pages 205, 206, 207, 208, 210 and 211 show details of damage to the fore topmast. Photo 1773-7, page 209 shows the broken main topmast. The main top mast was removed immediately after reboarding as a safety measure. Both of the masts are wood.

TOP SECRET

Sunk	Ship	Type	Distance	Damage to below deck supports	Air Speed	Pressure	Approximate distance to nearest mast or tower
X	Gilliam	APA	90		1230	82	Superstructure suffered heavily & mastlike structure loosened. Superstructure blown off.
X	Skate	SS	400		1230	82	
X	Carlisle	APA	400		1080	66	
	Sakawa	CL	450		950	52	
	YO 160	YO	500		720	36	
X	Anderson	DD	390		700	34	
	Grittenden	APA	600		700	34	
	Arkansas	BB	600	X	700	34	
	Nevada	BB	600		700	34	
	Independence	CVL	610		680	33	Masts, etc. blown overboard.
X	Lamson	DD	700		555	25	
	Penascola	CA	700	X	555	25	
	Dawson	APA	850		400	16	
	Salt Lake City	CA	900		370	14	
	Hughes	DD	900		370	14	
	Brule	APA	950		335	13	
	Rhind	DD	1000		300	11	
	Talbot	DD	1100		250	9	
	Eugen	CA	1200		225	8	Wood mast.

TOP SECRET

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

SECTION III - CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions.

1. Serious damage to both topmasts and basic mast structure of existing designs should be expected within 800 yards of the point of burst of an atomic bomb under the conditions of Test A. Within range, air velocities of about 500 miles per hour and pressures of the order of 25# per square inch carry away rigging, bend the topmasts so severely as to make radar inoperable, destroy halyards, bend and twist yardarms, and cause failures in tripods. Life lines, rails, davits and booms of various types suffer sufficient damage to make them inoperable, where they are not protected from the blast wave.

2. Over 800 yards from the point of burst, present day mast structures will probably suffer only minor damage to topmasts. Except in the case of wooden poles as on PRINZ EUGEN, the basic mast structure will be unaffected.

3. Experience with the results of Test A indicate that the critical range for heavy ships, i.e., BB, CV and strong hulled ships such as submarines is about 800 yards. Beyond this range these ships may expect retain use of much of the equipment installed on their masts.

4. Lighter ships such as CA, CL, CVL, DD and auxiliary classes should not expect retain the major portion of their mast equipment within a range of 1000 yards from the point of burst.

5. The rigging fittings are more vulnerable than the wire.

6. Davits operating in tracks and presenting a broad face to the blast are a particular source of trouble.

B. Recommendations.

1. All structures, whether masts, yardarms, stanchions, davits

TOP SECRET

Page 19 of 211 Pages

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

or booms, which rest on a single base and have a high slenderness ratio are extremely vulnerable to attack by the wind and pressure wave. Tripod structures show considerably less vulnerability to attack unless the directional effect is such that the structure pivots about two legs; in which event the pressure on the third leg will probably be sufficient to cause damage to that leg and to the supports below decks. Since these conditions are inherent in the type of structure, the ideal situation requires complete elimination of such structures from ships. Since operating requirements and economic considerations are not likely to permit such drastic changes, the following recommendations are suggested as a compromise:

- (a) Revise signalling methods to permit elimination of yardarms.
- (b) Shorten polemasts and use them only, as extensions on other structures.
- (c) In order to provide replacement for radar equipment lost during one attack, initiate studies leading to methods of housing auxiliary pole masts and radars in a low superstructure, aft.
- (d) Where use of tripods seems unavoidable, the height should be reduced to the minimum required, the legs should be fabricated of the lightest material and have the maximum reasonable diameter. The legs should penetrate all decks and carry to the shell of keel structure with heavy connections thereto. The tripods should carry the minimum of equipment which should be limited to essential radar, fire control, and ship control material.

2. The best solution, and the one which is appearing in the latest battleship designs, is the solid periphery tower which is well anchored to the keel and shell structure of the ship. Even here the amount of weight and type of equipment placed in such towers should be studied with the view of keeping all possible personnel and operations within the main hull of the ship.

TOP SECRET

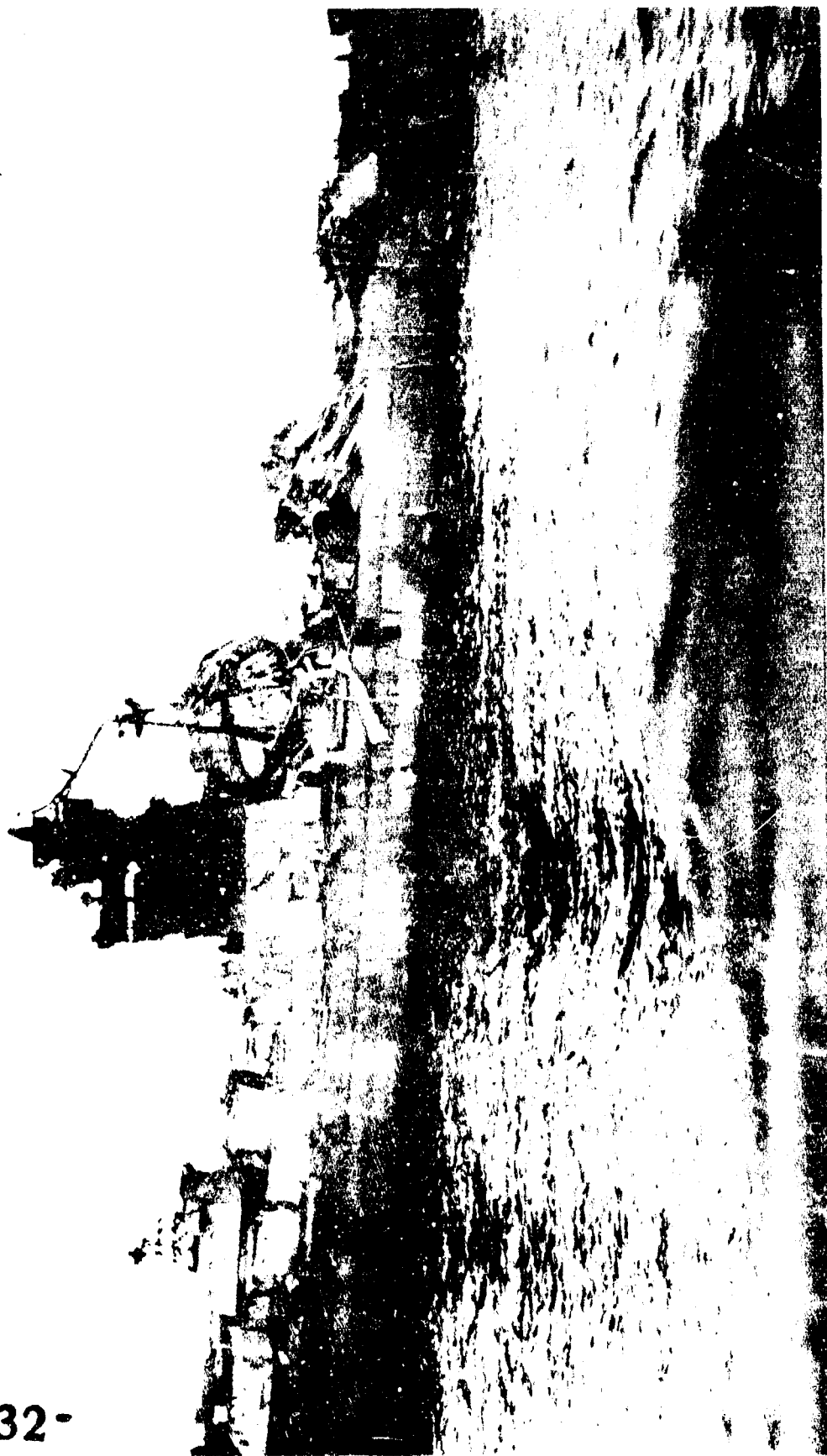
SECTION IV

PHOTOGRAPHS

FAILURES OF MASTS, YARDARMS, BOOMS AND RIGGING

TOP SECRET

Page 21 of 211 Pages

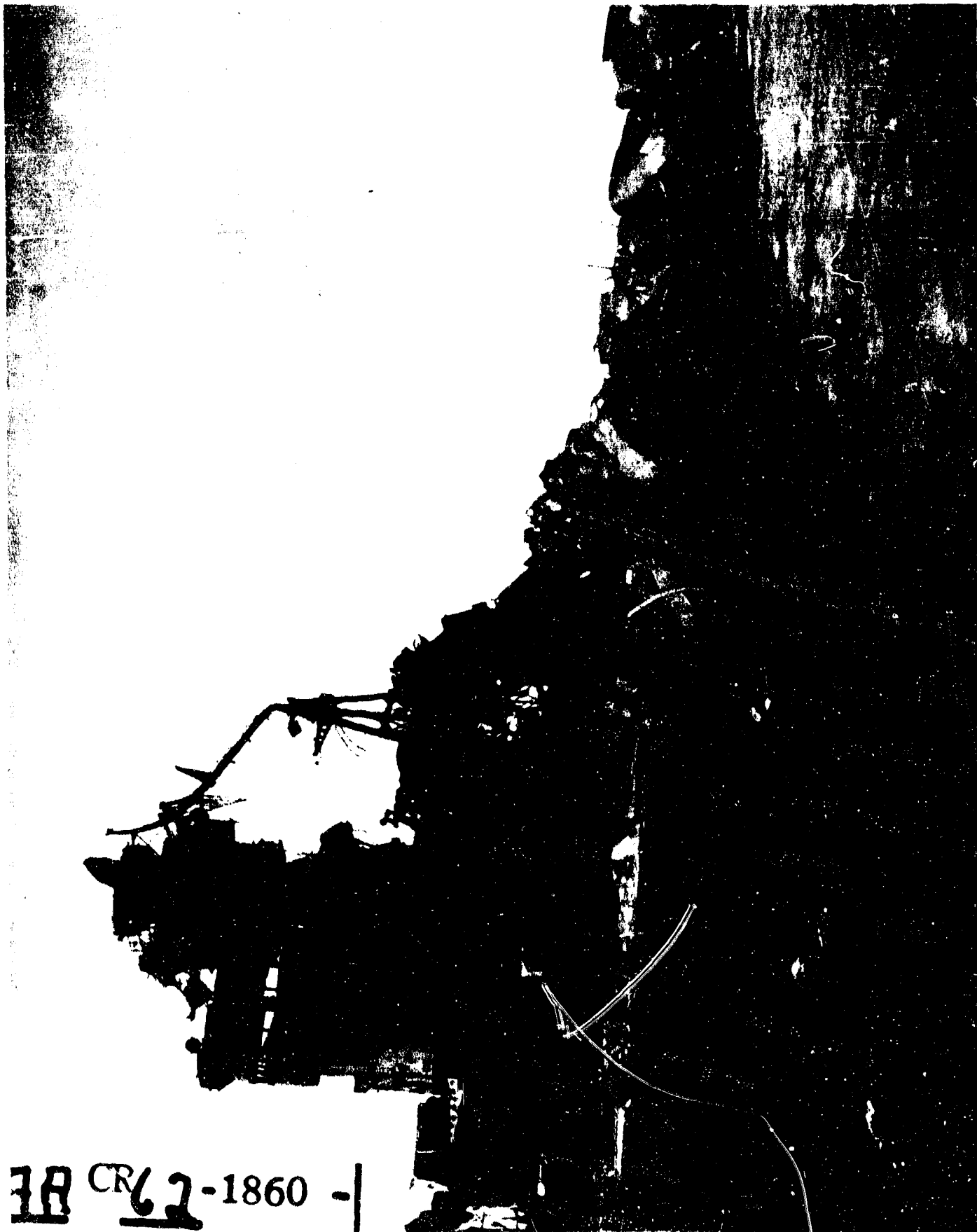


AA-CR-62-1832-

AA-CR-62-1832-4. SAKAWA (Ex-Jap Cruiser). View looking at port beam after Test A. Note that forward superstructure leans forward as does foremast and tripod. Note flattening of superstructure aft of forward tripod.

TOP SECRET

Page 22 of 211 Pages



1A CR 62-1860 -|

AA-CR-62-1860-2. SAKAWA (Ex-Jap Cruiser). View of port side showing superstructure and forward tripod after Test A.

TOP SECRET

Page 23 of 211 Pages

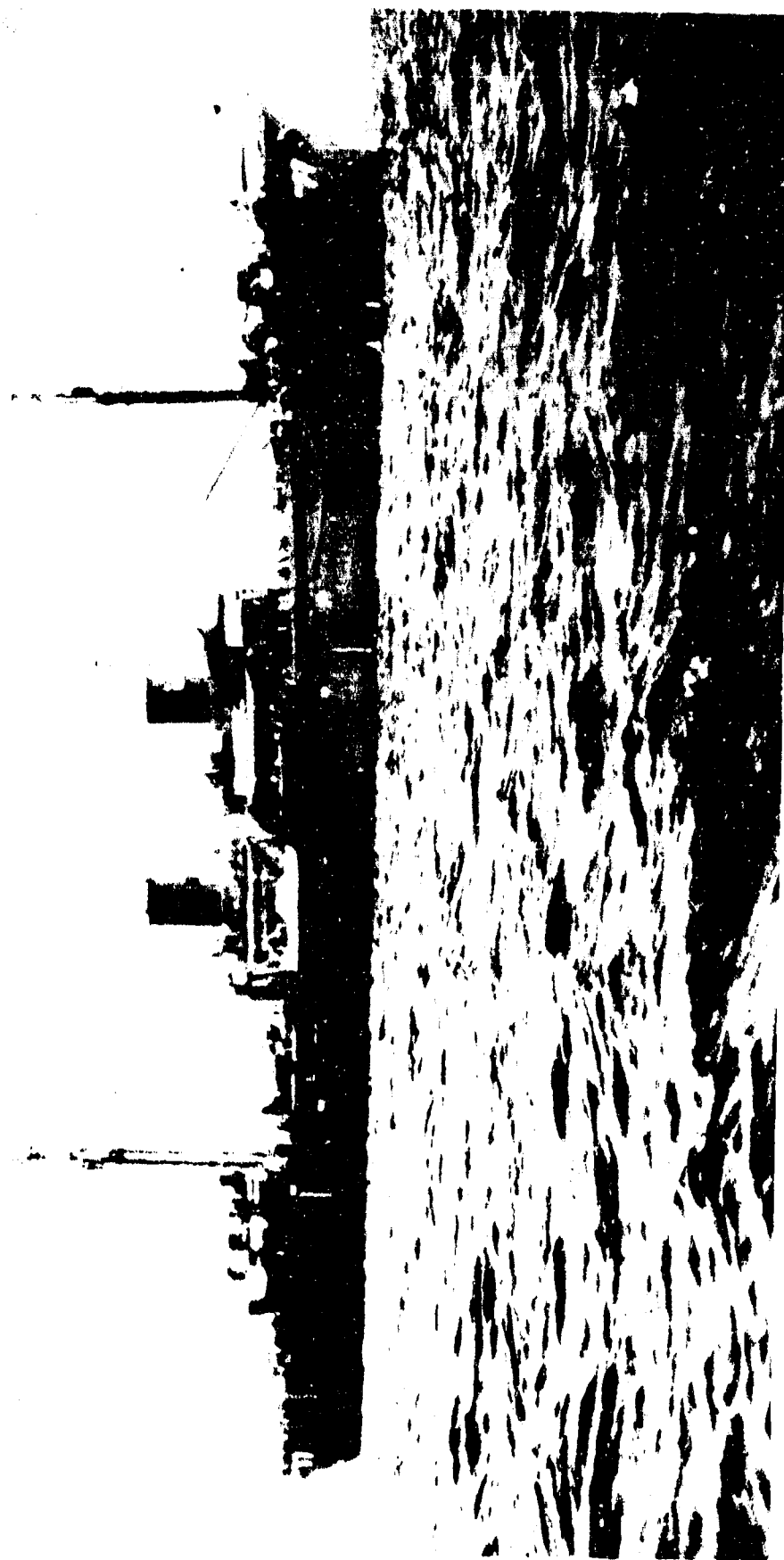


BA-CR-196-156-27 USS CRITTENDEN (APA77). View looking at starboard bow before Test A.

TOP SECRET

Page 24 of 211 pages

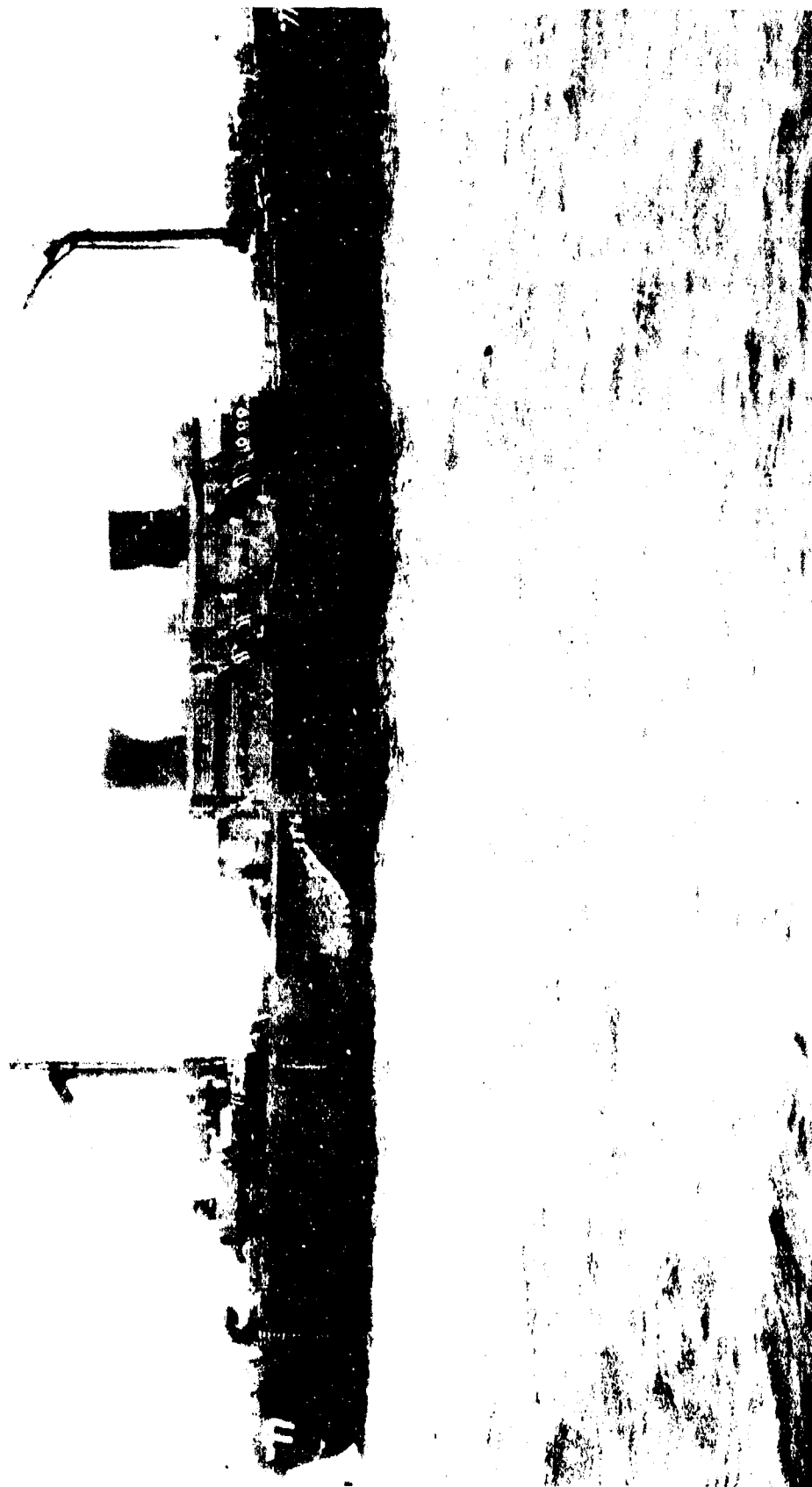
BAK 196 156-28 CRITTENDEN 12 JUNE 46



BA-CR-196-156-28. USS CRITTENDEN (APA77). View looking at starboard beam before Test A.

TOP SECRET

Page 25 of 211 Pages



AB-CR-227-49-116. USS CRITTENDEN (APA77). View looking at starboard beam after Test A.

TOP SECRET

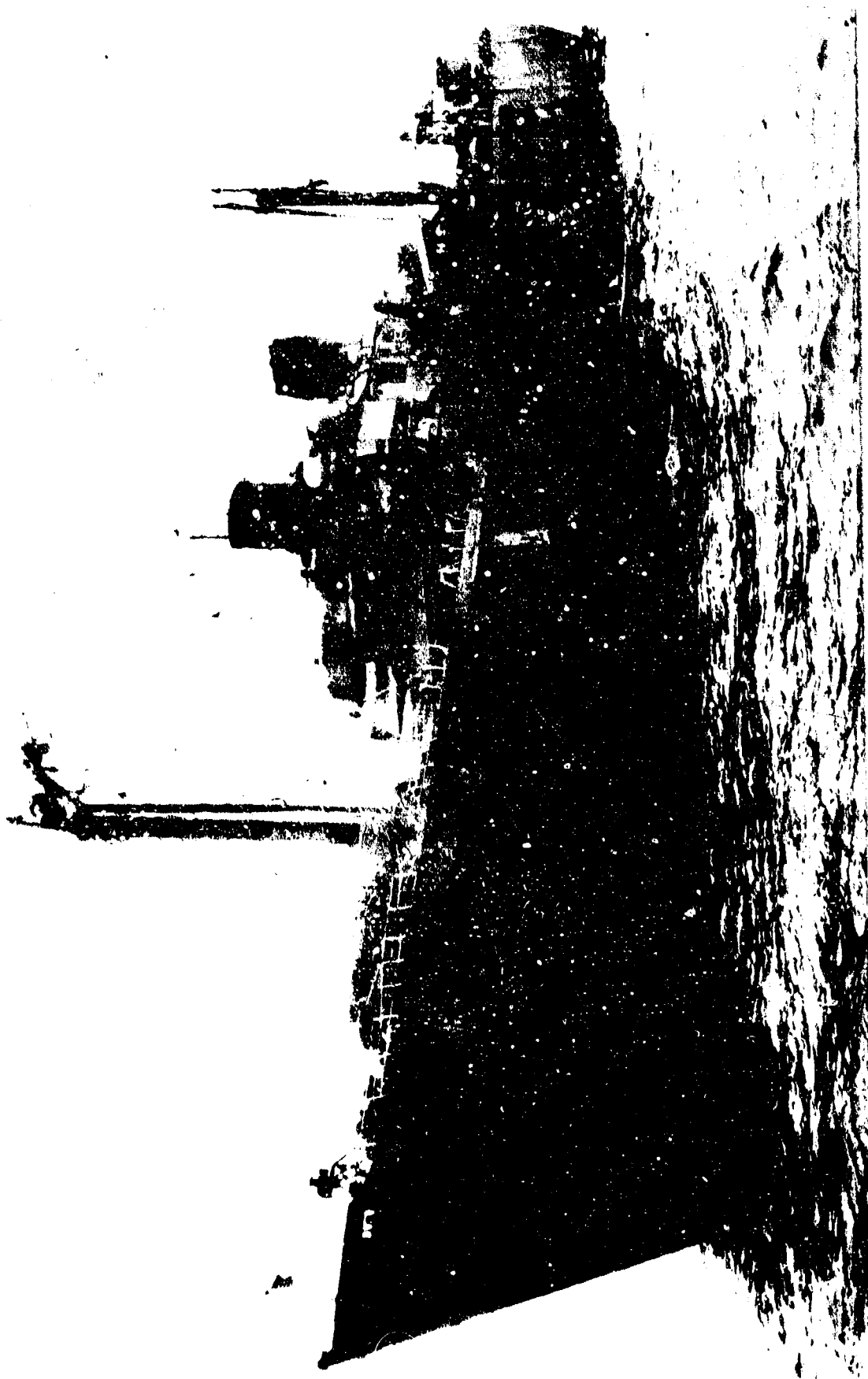
Page 26 of 211 Pages



AB-CR-227-49-114. USS CRITTENDEN (APA77). View looking at stern after Test A.

TOP SECRET

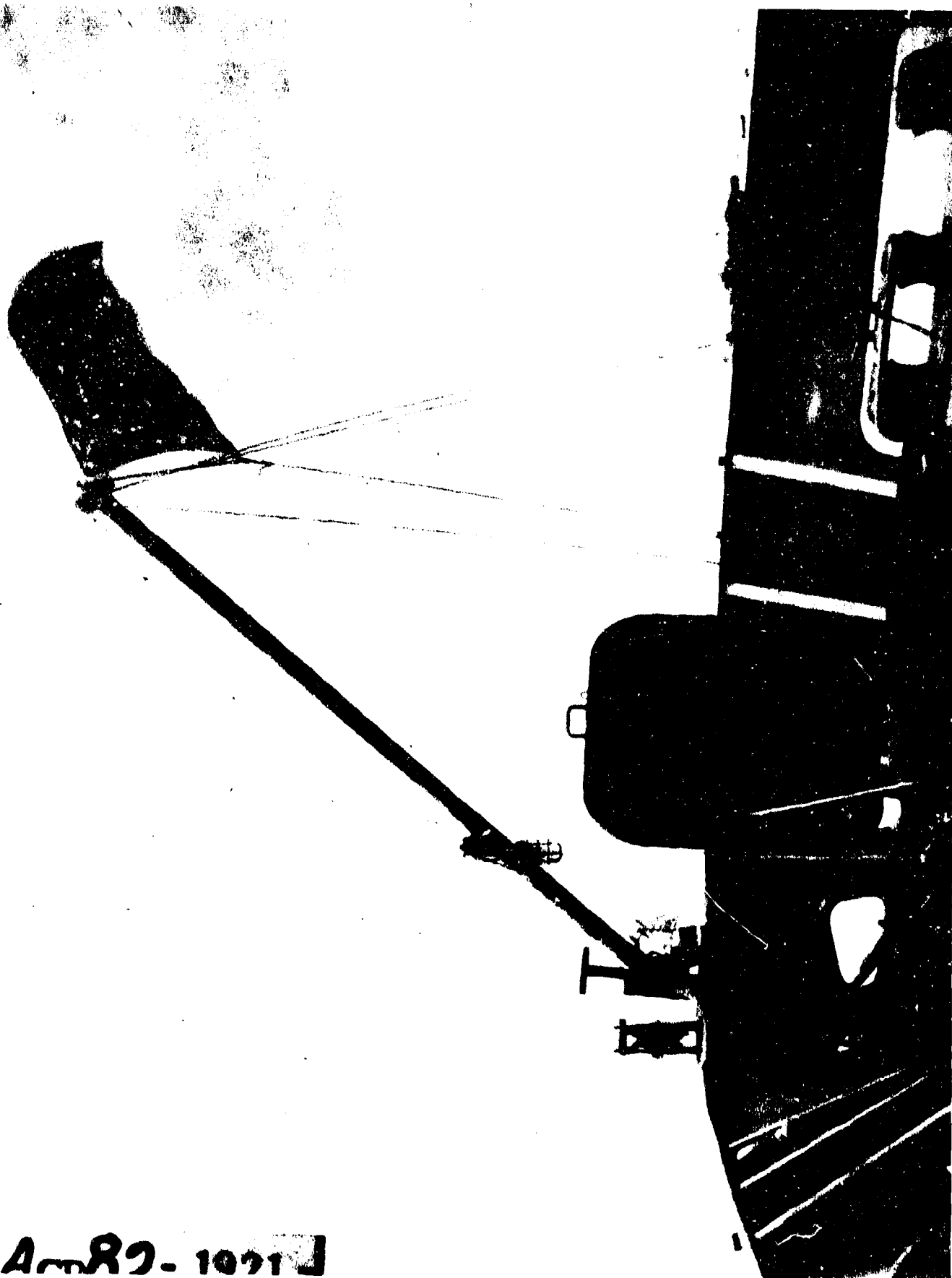
Page 27 of 211 Pages



AB-CR-227-49-119. USS CRITTENDEN (APA77). View looking at port bow after Test A.

TOP SECRET

Page 28 of 211 Pages

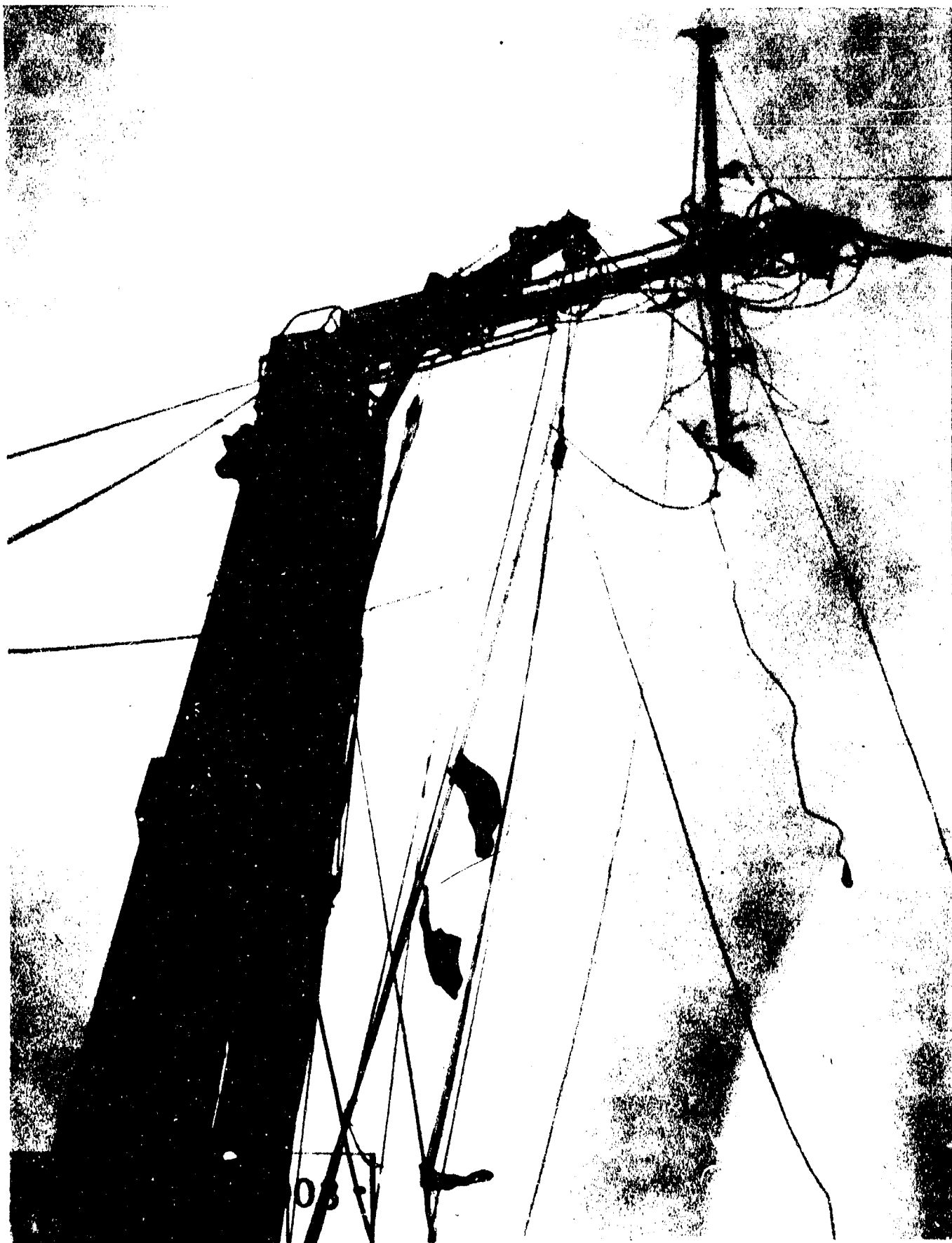


AA-CR-82-1921-11

AA-CR-82-1921-11. USS CRITTENDEN (APA77). Bent jackstaff.

TOP SECRET

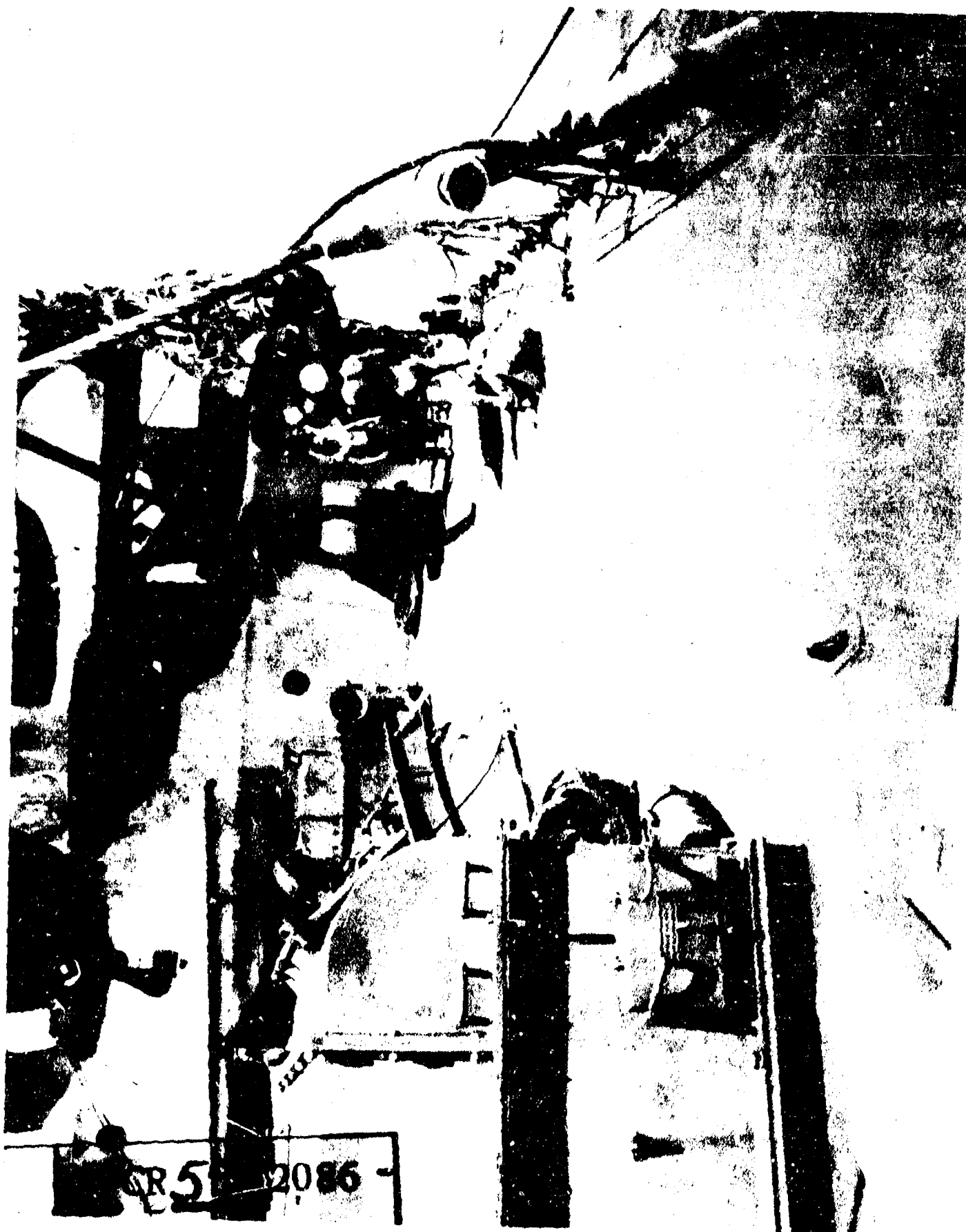
Page 29 of 211 Pages



AA-CR-80-1903-7. USS CRITTENDEN (APA77). Foremast, looking to starboard. Note sharp bend in port and starboard cargo booms.

TOP SECRET

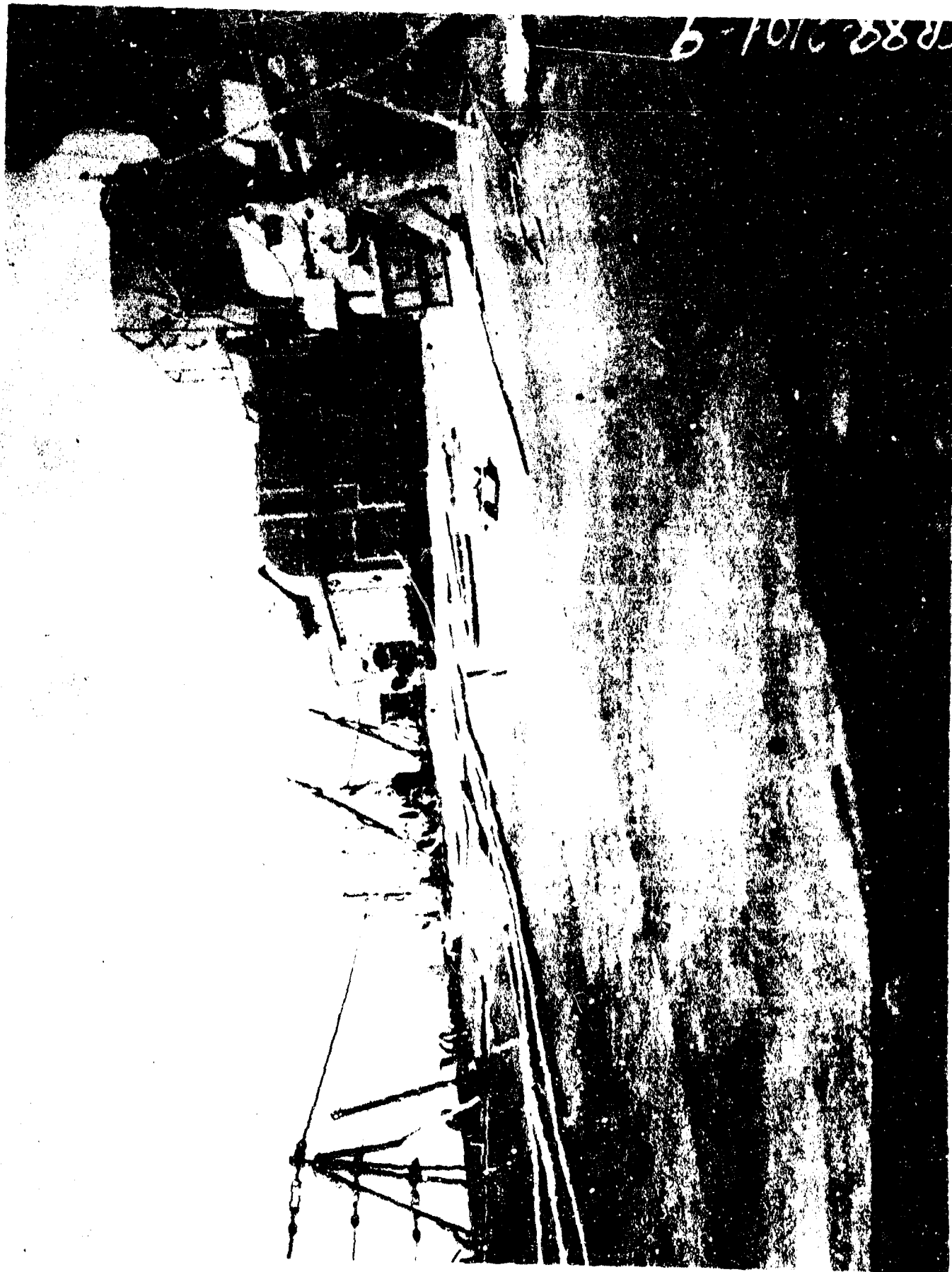
Page 30 of 211 Pages



AA-CR-59-2086-9. USS CRITTENDEN (APA77). Upper deck, port side, showing foremast stay turn-buckle.

TOP SECRET

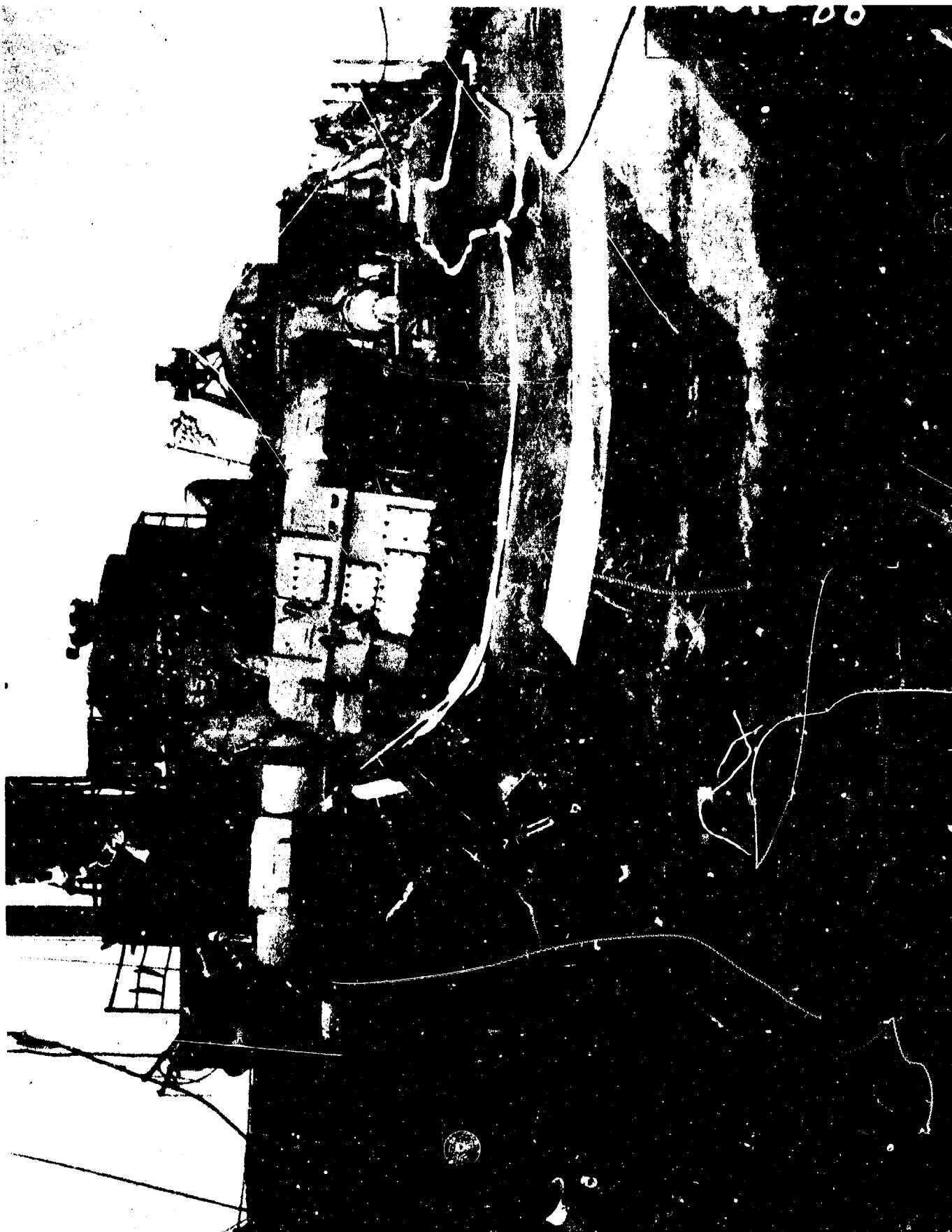
Page 31 of 211 Pages



AA-CR-88-2101-9. USS CRITTENDEN (APA77). Upper deck, port side, showing foremast stay turn-buckles.

TOP SECRET

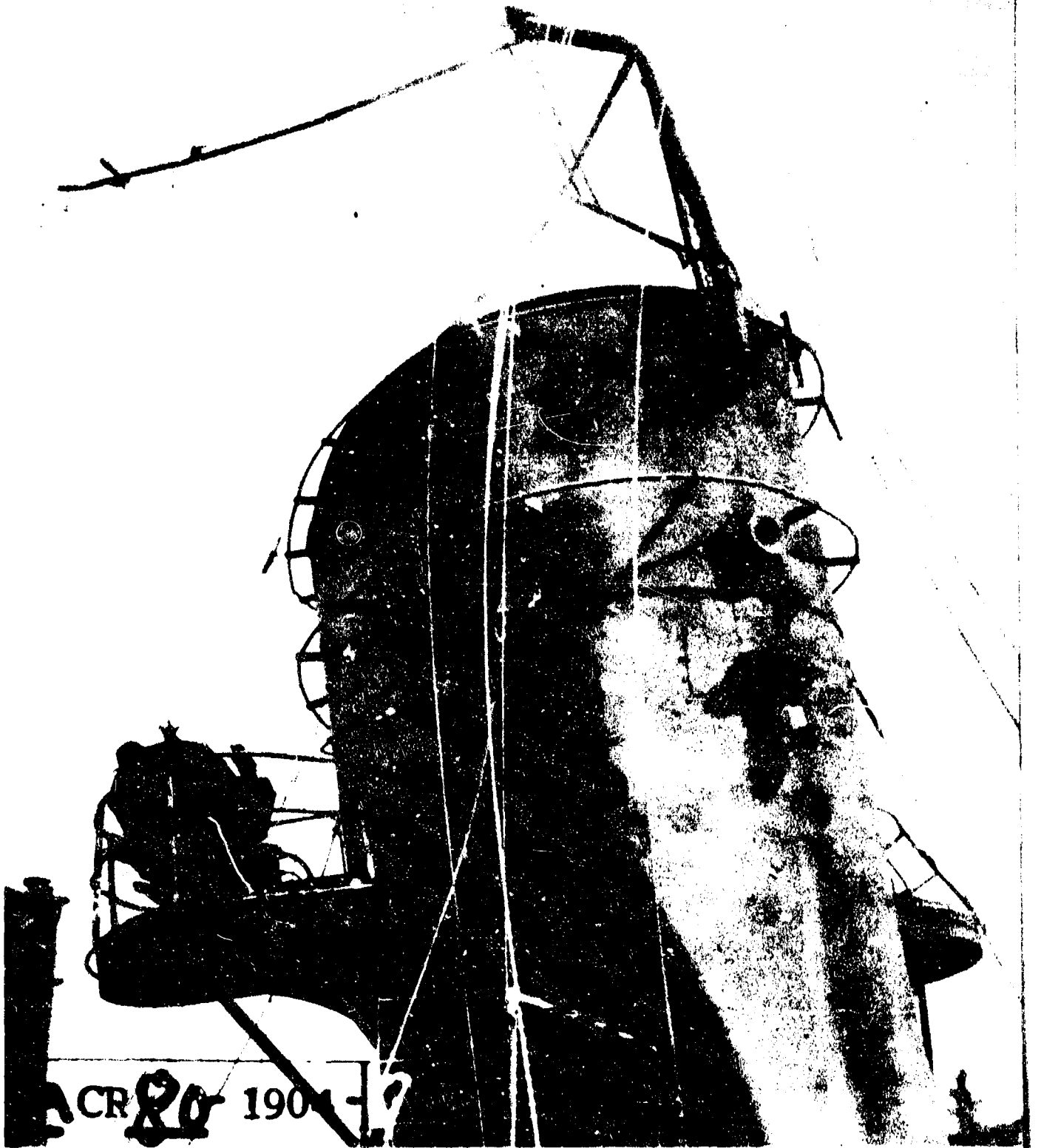
Page 32 of 211 Pages



AA-CR-88-2101-12. USS CRITTENDEN (APA77). Upper deck, starboard side, showing foremast stay turn-buckles.

TOP SECRET

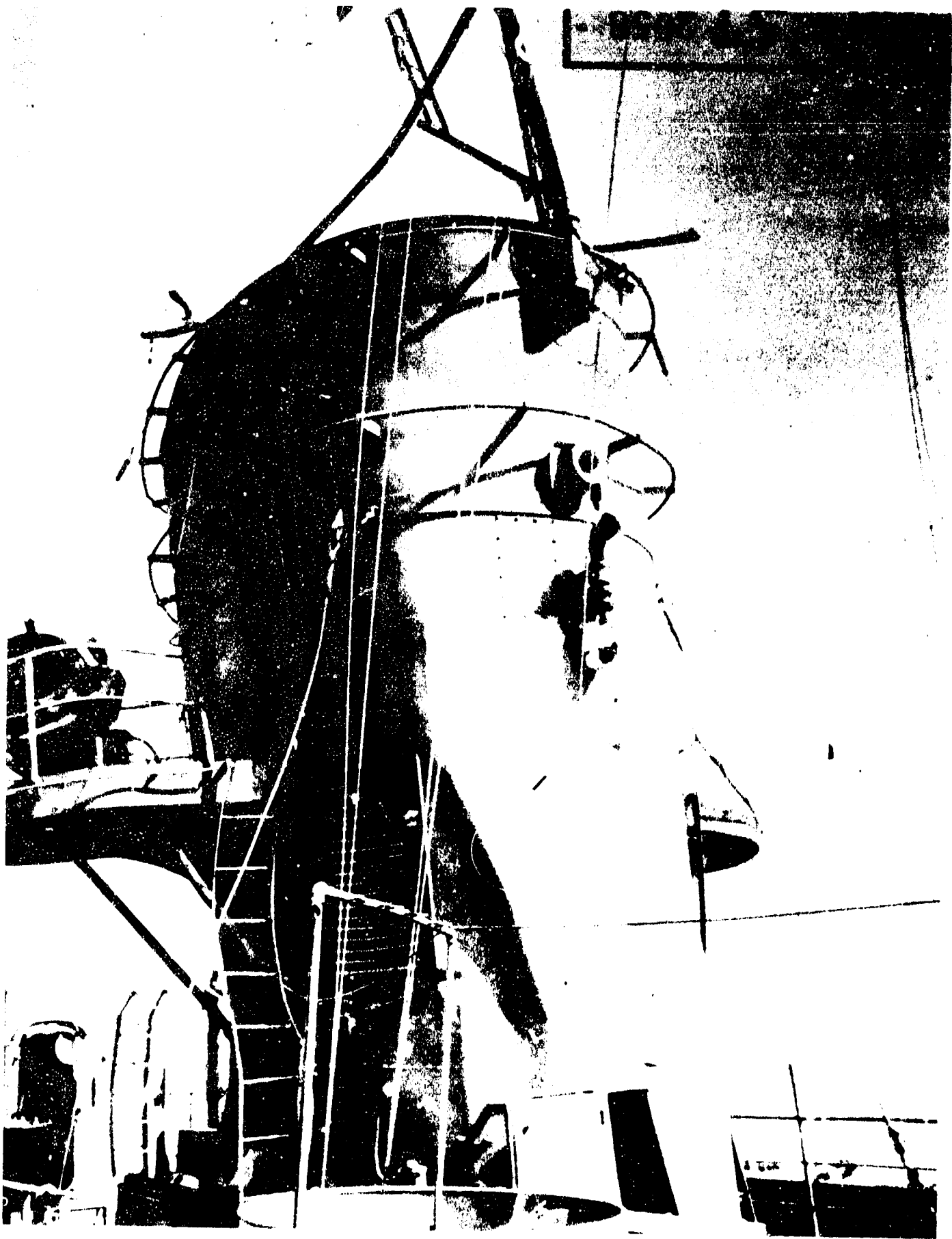
Page 33 of 211 Pages



AA-CR-80-1904-7. USS CRITTENDEN (APA77). Signal mast on forward smokestack. Looking aft and to port.

TOP SECRET

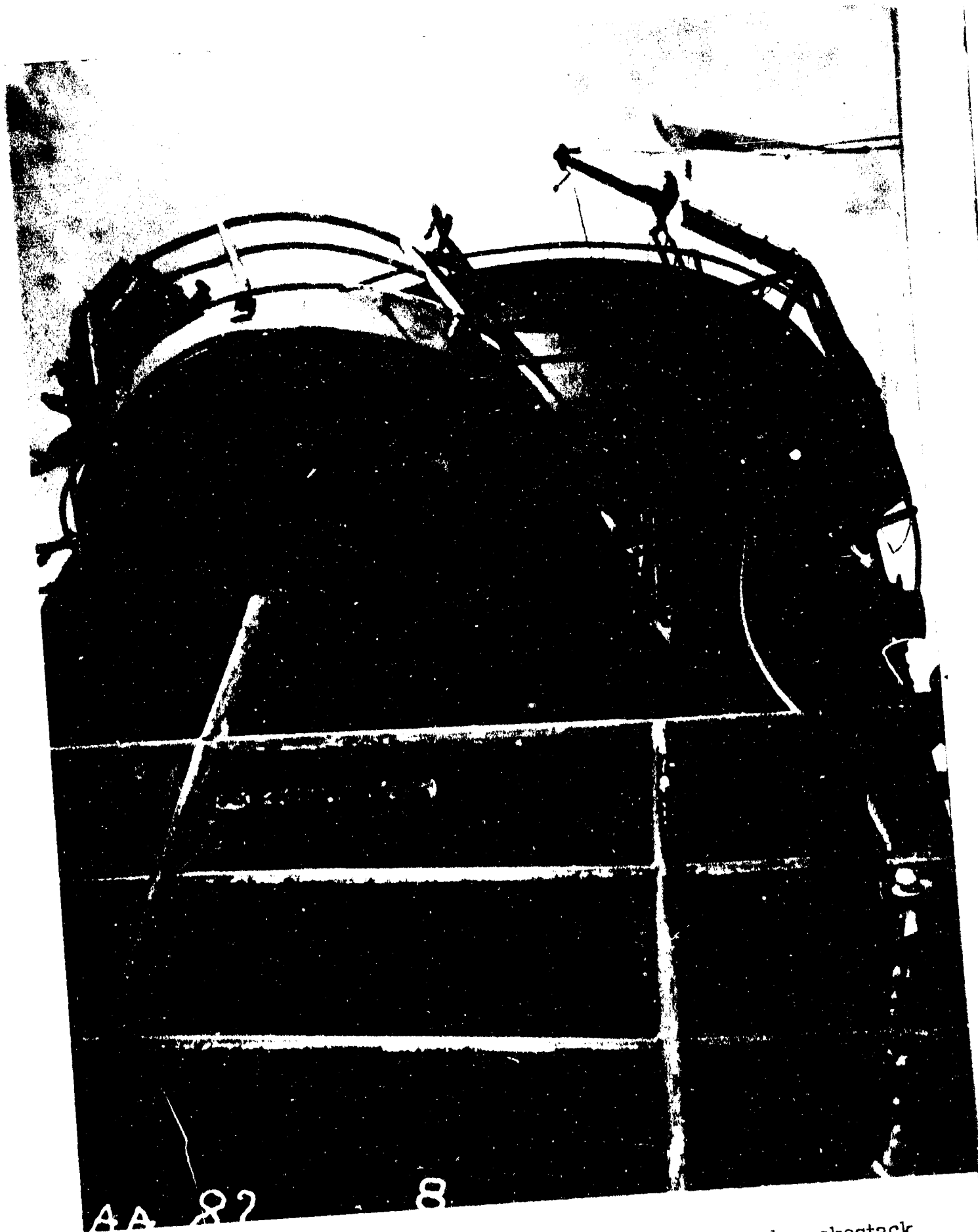
Page 34 of 211 Pages



AA-CR-59-2058-9. USS CRITTENDEN (APA77). Forward smokestack showing lower portion of signal mast.

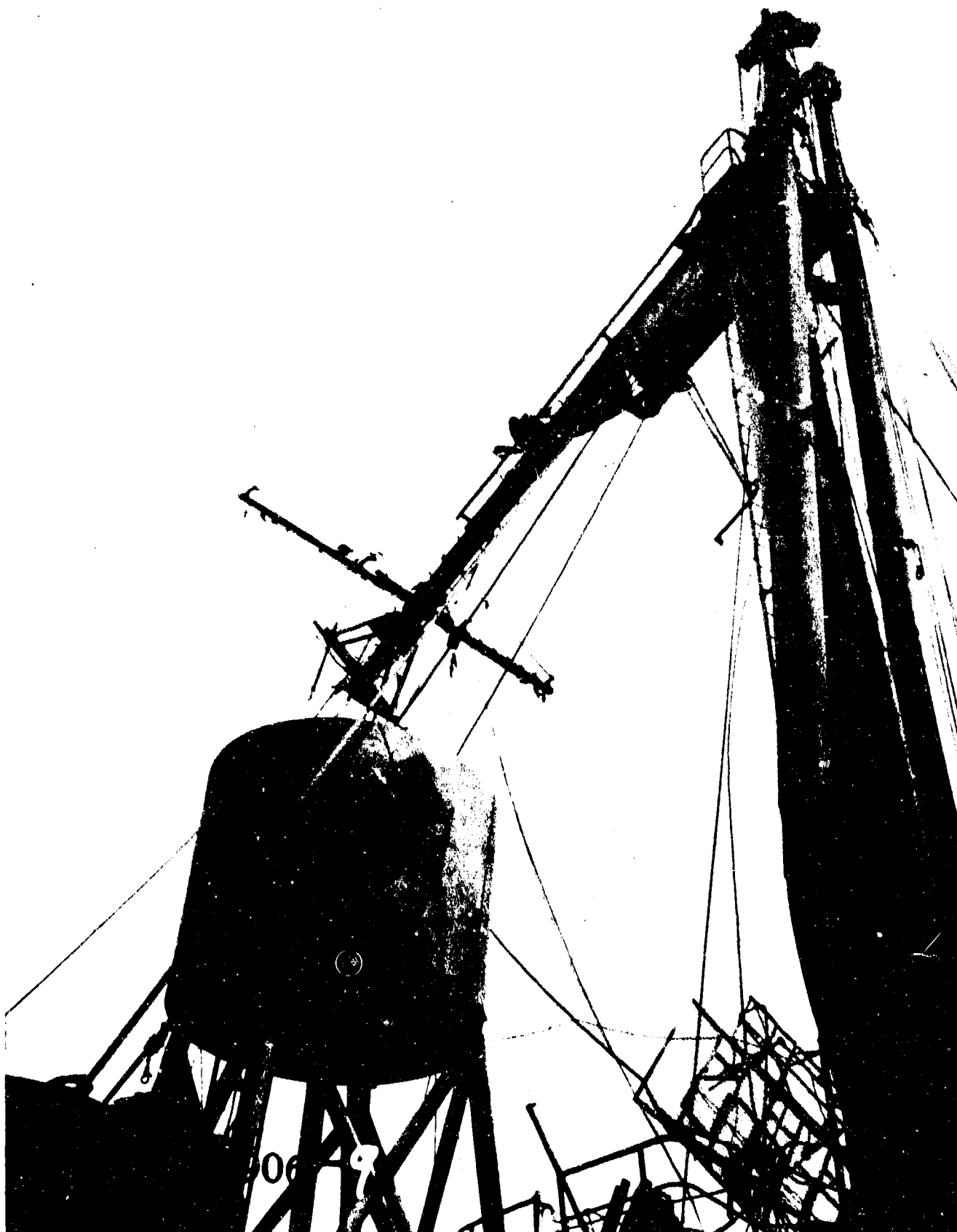
TOP SECRET

Page 35 of 211 Pages



AA-CR-82-1922-8. U.S.S. CRITTENDEN (APA-77). Forward smokestack and signal mast.

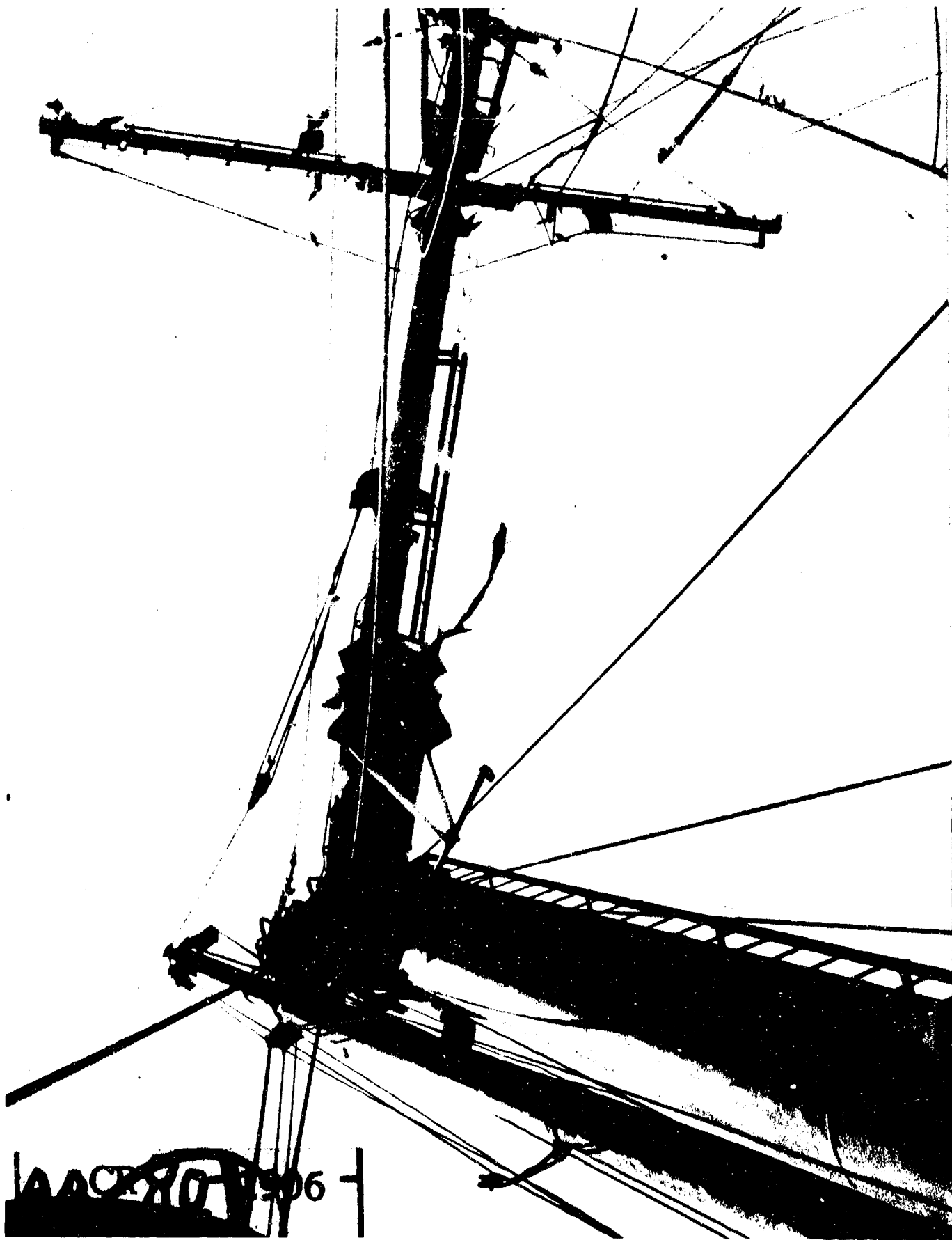
TOP SECRET



AA-CR-80-1906-9. U.S.S. CRITTENDEN (APA-77). Mainmast. Note relatively sharp bend of starboard cargo boom, and long easy curve of port cargo boom.

TOP SECRET

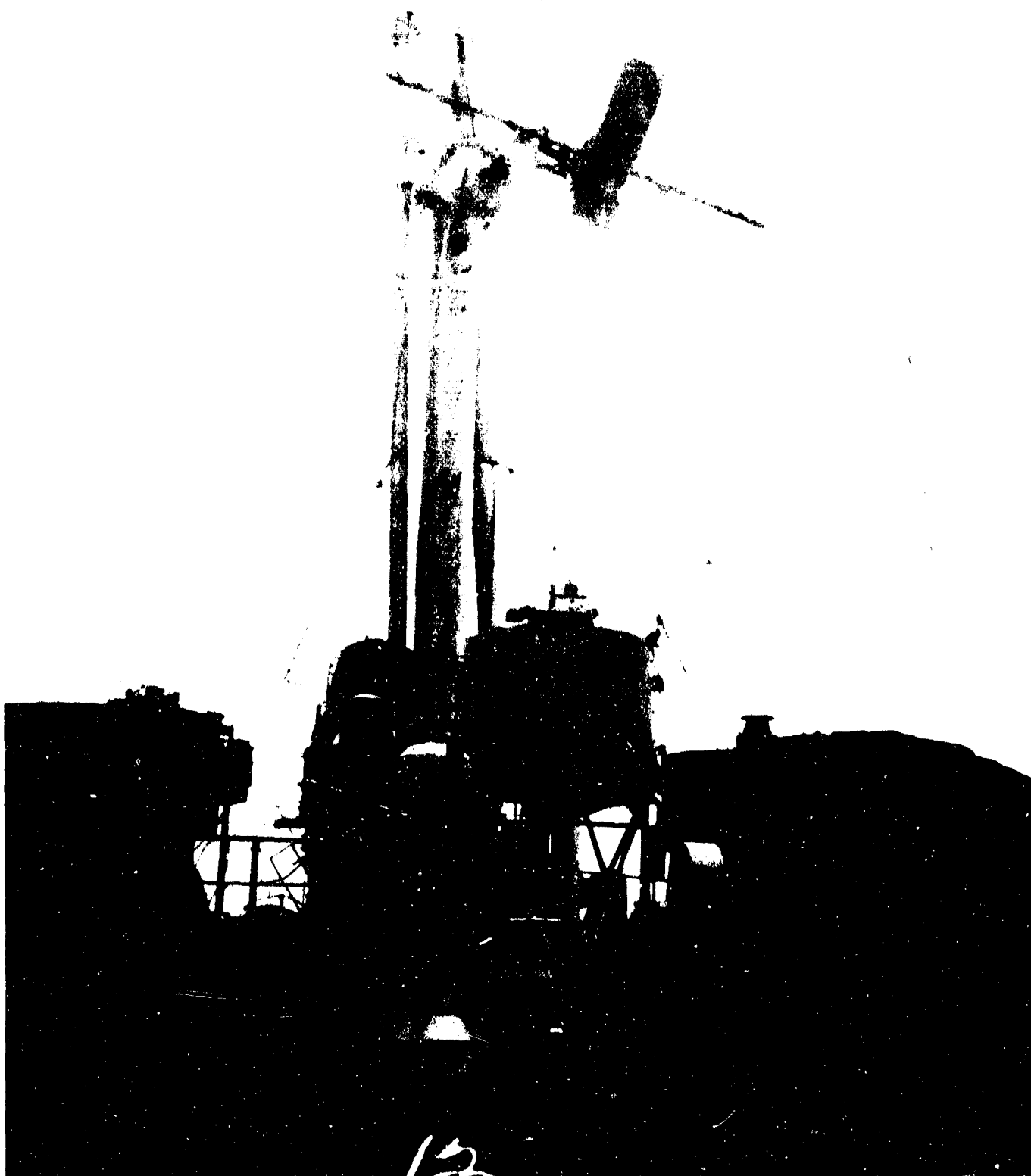
Page 37 of 211 Pages



AA-CR-80-1906-12. U.S.S. CRITTENDEN (APA77). Maintopmast.
Looking up from top of after deckhouse.

TOP SECRET

Page 38 of 211 Pages



AA-CR-82-1921-12. U.S.S. CRITTENDEN (APA-77). Mainmast. Looking forward from upper deck at stern.

TOP SECRET

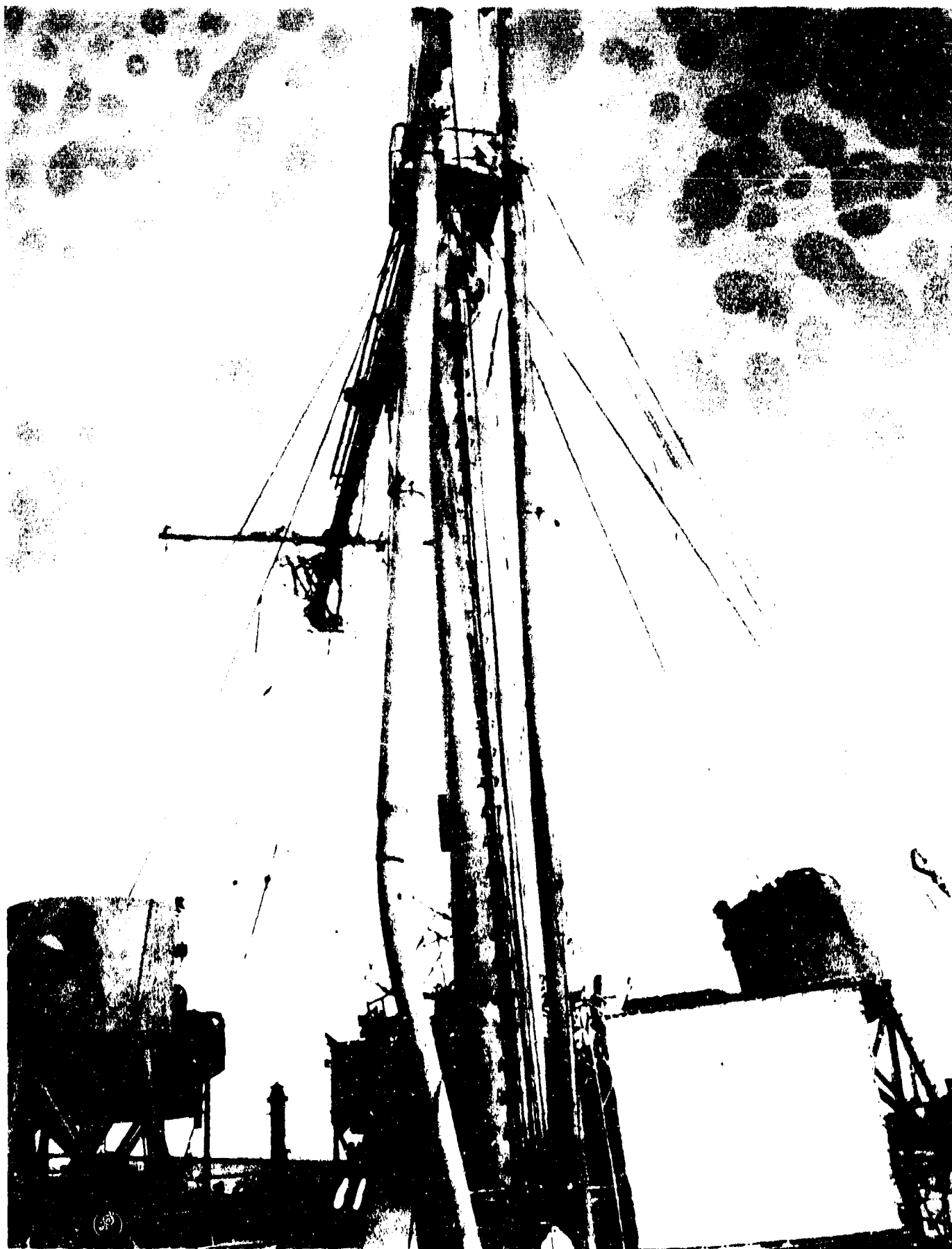
Page 39 of 211 Pages



AA-CR-82-1922-2. USS CRITTENDEN (APA77). Mainmast and port and starboard cargo booms.

TOP SECRET

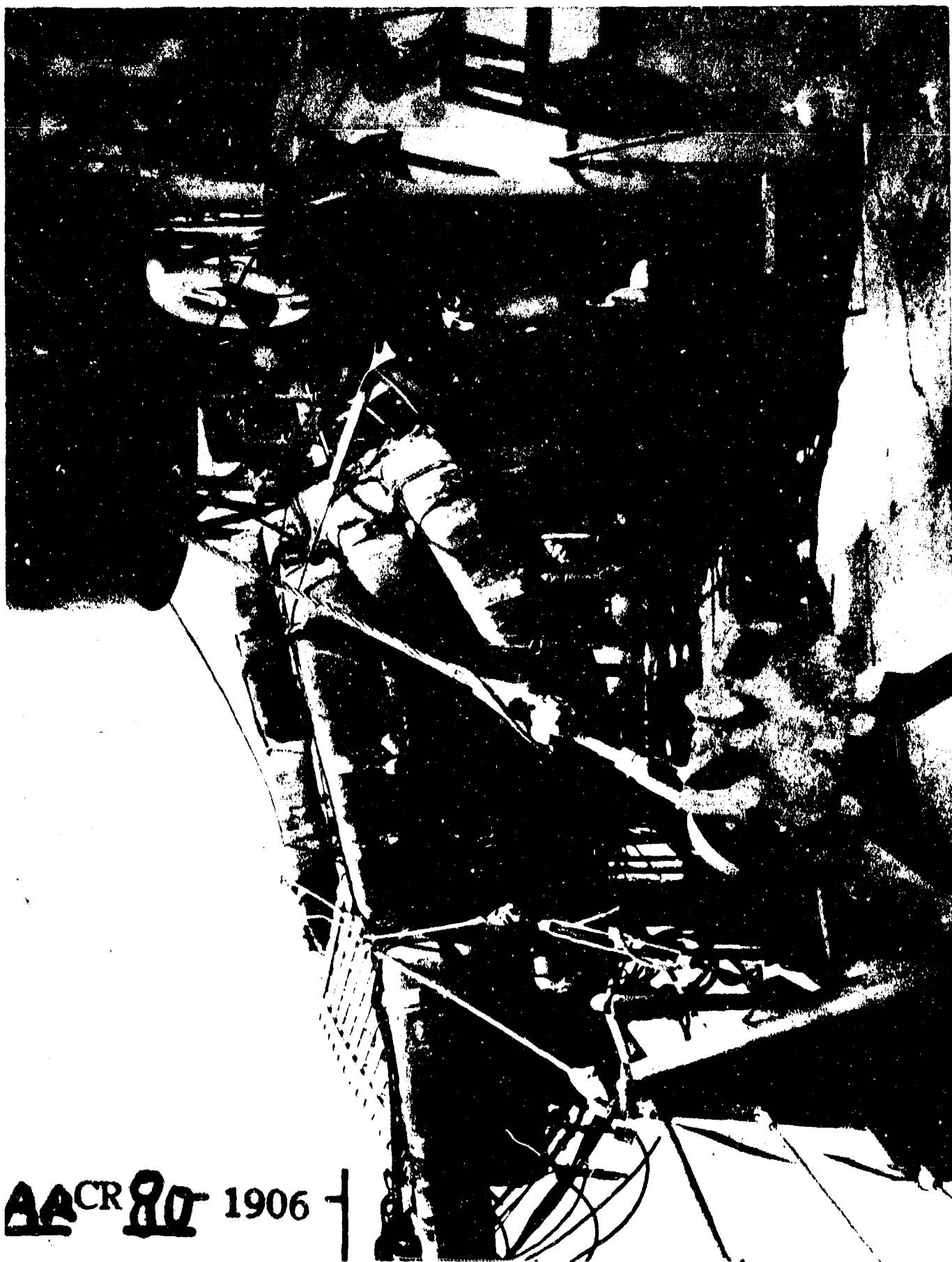
Page 40 of 211 Pages



AA-CR-80-1905-11. USS CRITTENDEN (APA-77). Mainmast. Note bend and kink in starboard cargo boom.

TOP SECRET

Page 41 of 211 Pages

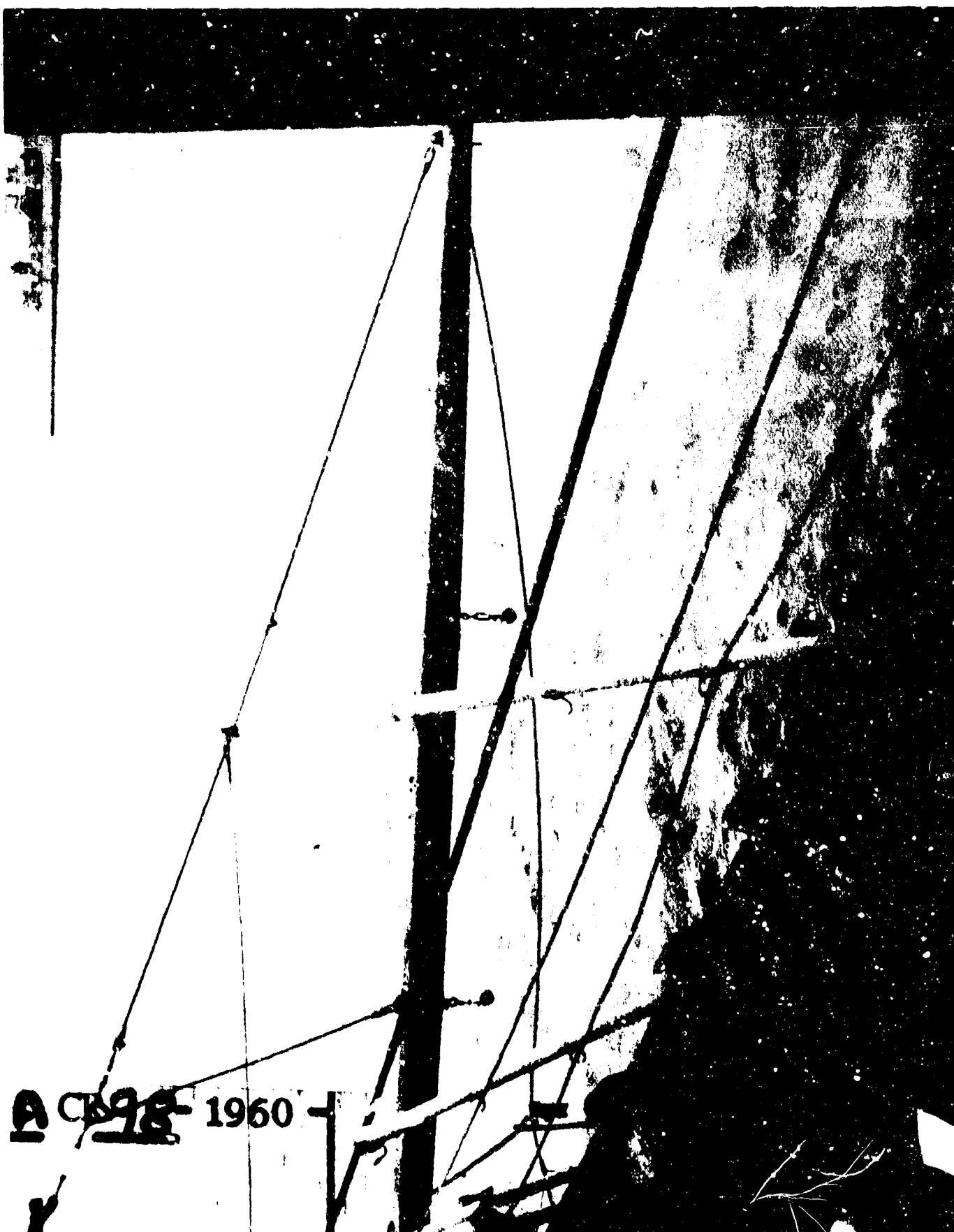


AA^{CR} 80 1906

AA-CR-80-1906-8. USS CRITTENDEN (APA-77). Upper deck, starboard side, looking aft, showing turn-buckles to mainmast rigging.

TOP SECRET

Page 42 of 211 Pages



AA-CR-98-1960-12. USS CRITTENDEN (APA77). Port boat boom knocked out of clamp.

TOP SECRET

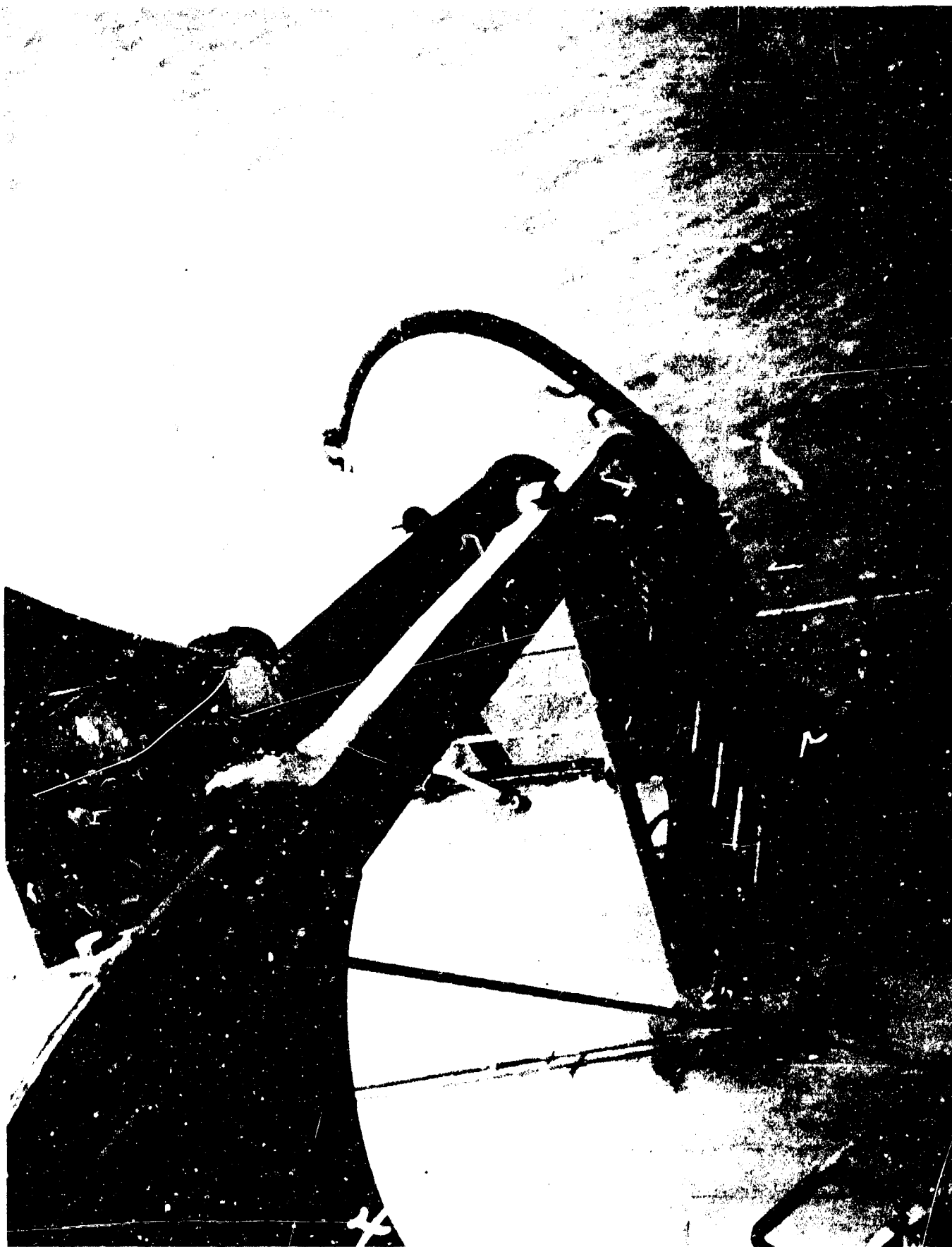
Page 43 of 211 Pages



AA-CR-82-1922-3. USS CRITTENDEN (APA77). General view of No. 4 - port after boat davit.

TOP SECRET

Page 44 of 211 Pages



AA-CR-82-1922-4. USS CRITTENDEN (APA77). Forward area of No. 4 boat davit. Note twisted flange and bend in auxiliary davit.

TOP SECRET

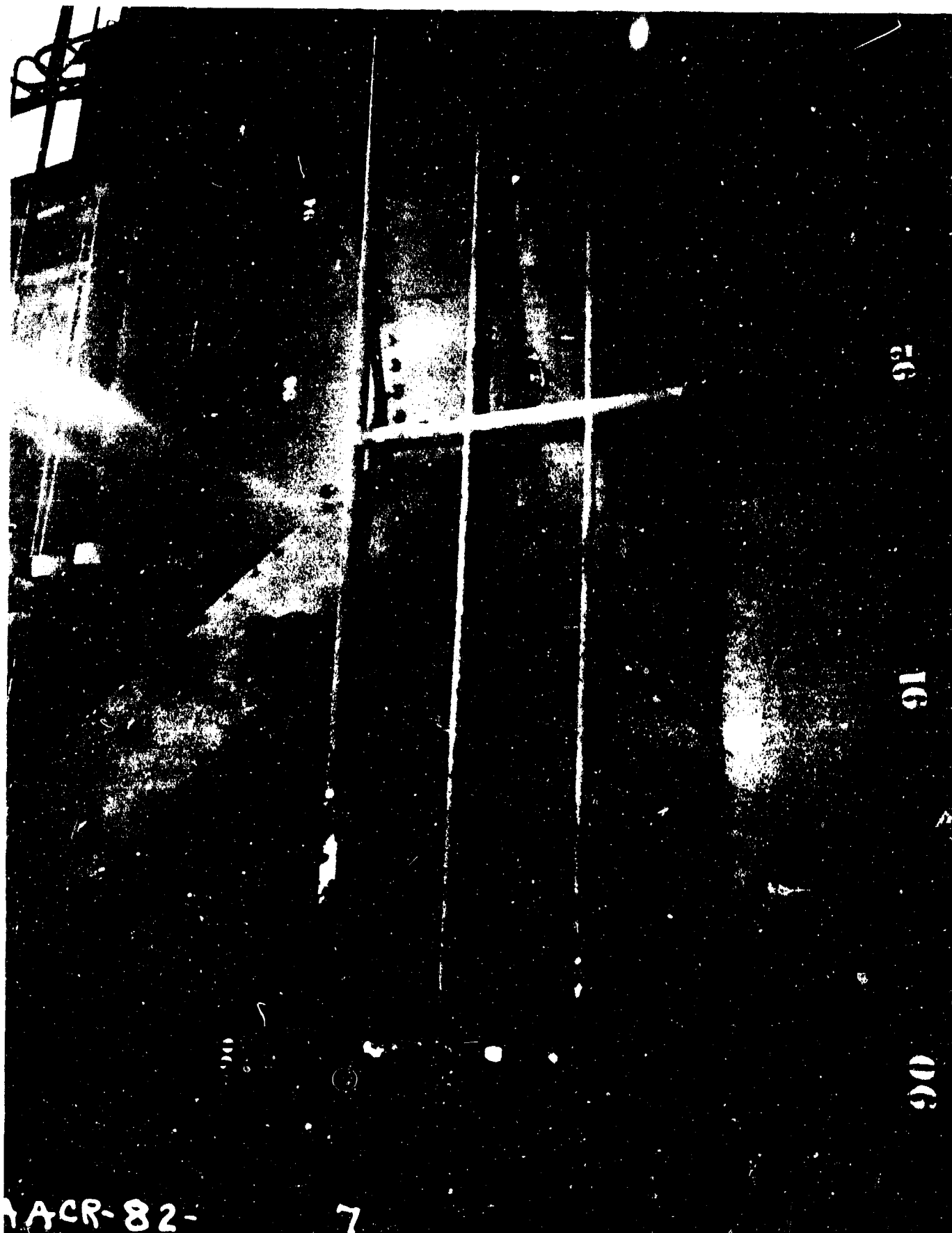
Page 45 of 211 Pages



AA-CR-82-1922-6. USS CRITTENDEN (APA77). No. 4 davit - looking up and outboard from below.

TOP SECRET

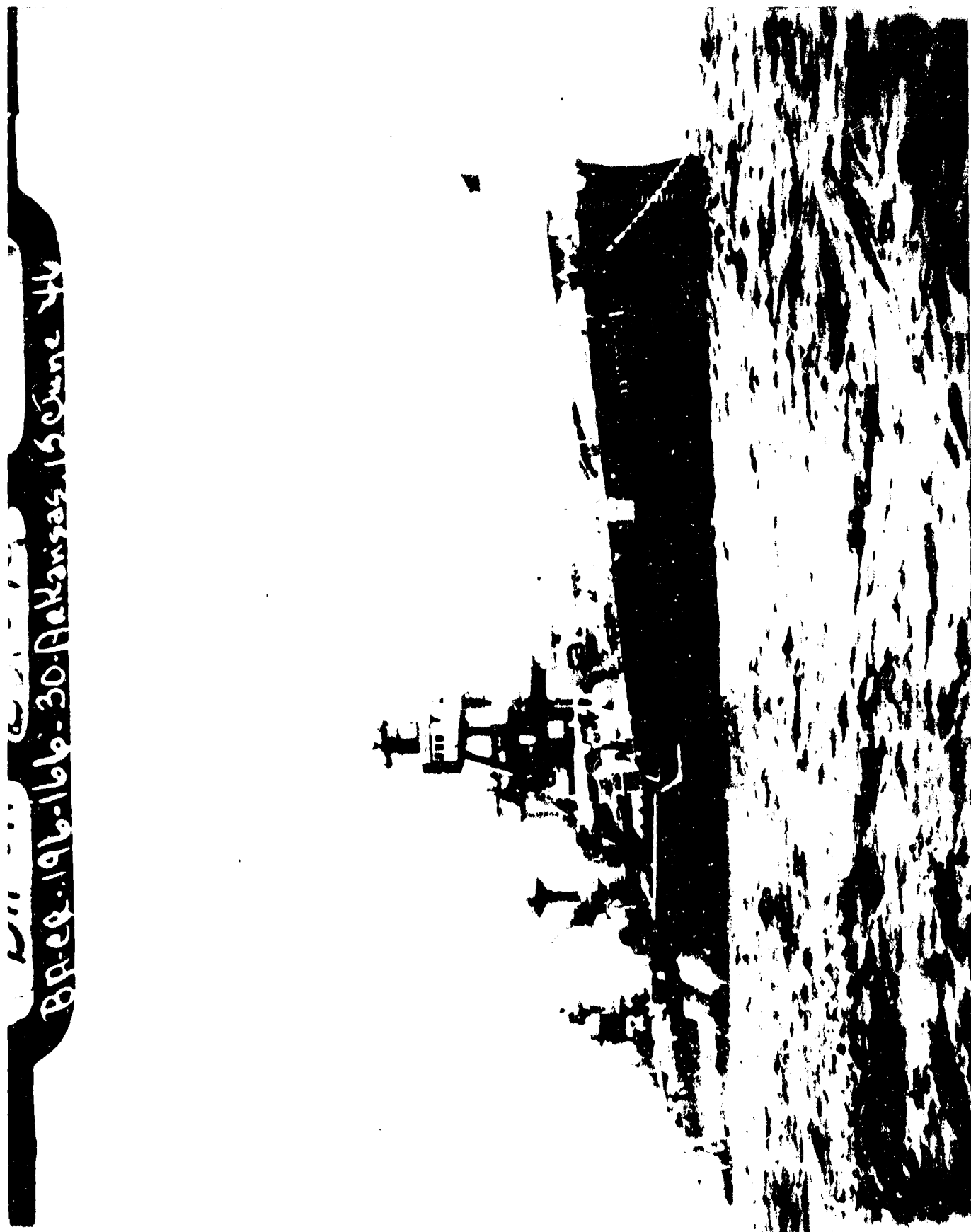
Page 46 of 211 Pages



AA-CR-82-1922-7. USS CRITTENDEN (APA77). No. 4 davit - head of forward arm and forward end of strong back.

TOP SECRET

Page 47 of 211 Pages



BA-CR-196-166-30. USS ARKANSAS (BB33). View before Test Able looking at the starboard bow.

TOP SECRET

Page 48 of 211 Pages

BA-CR-196-166-33



BA-CR-196-166-33. USS ARKANSAS (BB33). View before Test Able looking at port side.

TOP SECRET

Page 49 of 211 Pages



BA-CR-196-166-34. USS ARKANSAS (BB33). View before Test Able looking at the port quarter.

TOP SECRET

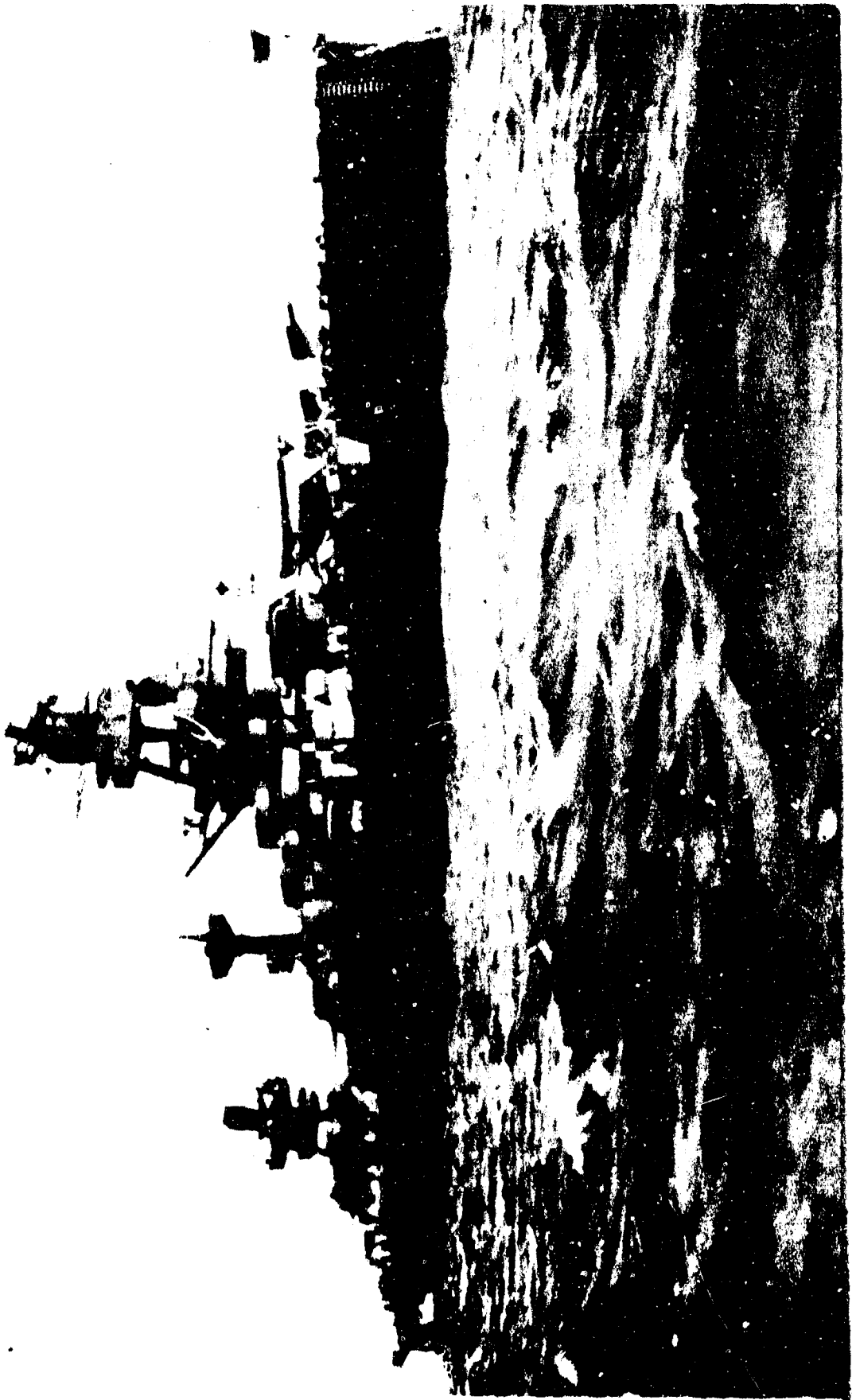
Page 50 of 211 Pages



AA-CR-227-91-40. USS ARKANSAS (BB33). View after Test Able looking at the port quarter.

TOP SECRET

Page 51 of 211 Pages



AA-CR-227-91-42. USS ARKANSAS (BB33). View after Test Able looking at the starboard bow.

TOP SECRET

Page 52 of 211 Pages



AA-CR-227-91-45. USS ARKANSAS (BB33). View after Test Able looking at the port side.

TOP SECRET

Page 53 of 211 Pages



AA-CR-68-2091-3. USS ARKANSAS (BB33). View looking aft at forward superstructure showing SK radar mast and yardarms.

TOP SECRET

Page 54 of 211 Pages



AA-CR-68-2094-1. USS ARKANSAS (BB33). Forward yardarms, SK radar pole and platform.

TOP SECRET

Page 55 of 211 Pages



AA-CR-68-2094-3. USS ARKANSAS (BB33). SK radar platform and forward tripod showing deformation of starboard wing. Note that struts appear unaffected.

TOP SECRET

Page 56 of 211 Pages



AA-CR-68-2094-7. USS ARKANSAS (BB33). Failure in after starboard leg of forward tripod in way of supporting bracket for range finder platform. Looking forward at inboard side of bracket, for opposite of this bracket see 2094-8.

TOP SECRET

Page 57 of 211 Pages



AA-CR-68-2094-8. USS ARKANSAS (BB33). Looking inboard at after side board leg of forward tripod. Note break in weld at flange of deep bracket and tear in leg, also break in weld on channel flange and lower part of wrapper plate near top of wrapper plate. See 2094-7. See also 2094-9 for tear in leg in way of channel.

TOP SECRET

Page 53 of 211 Pages



AA-CR-68-2094-9. USS ARKANSAS (BB33). Starboard leg of forward tripod in way of 10" channel showing break in weld and in leg see also 2094-8.

TOP SECRET

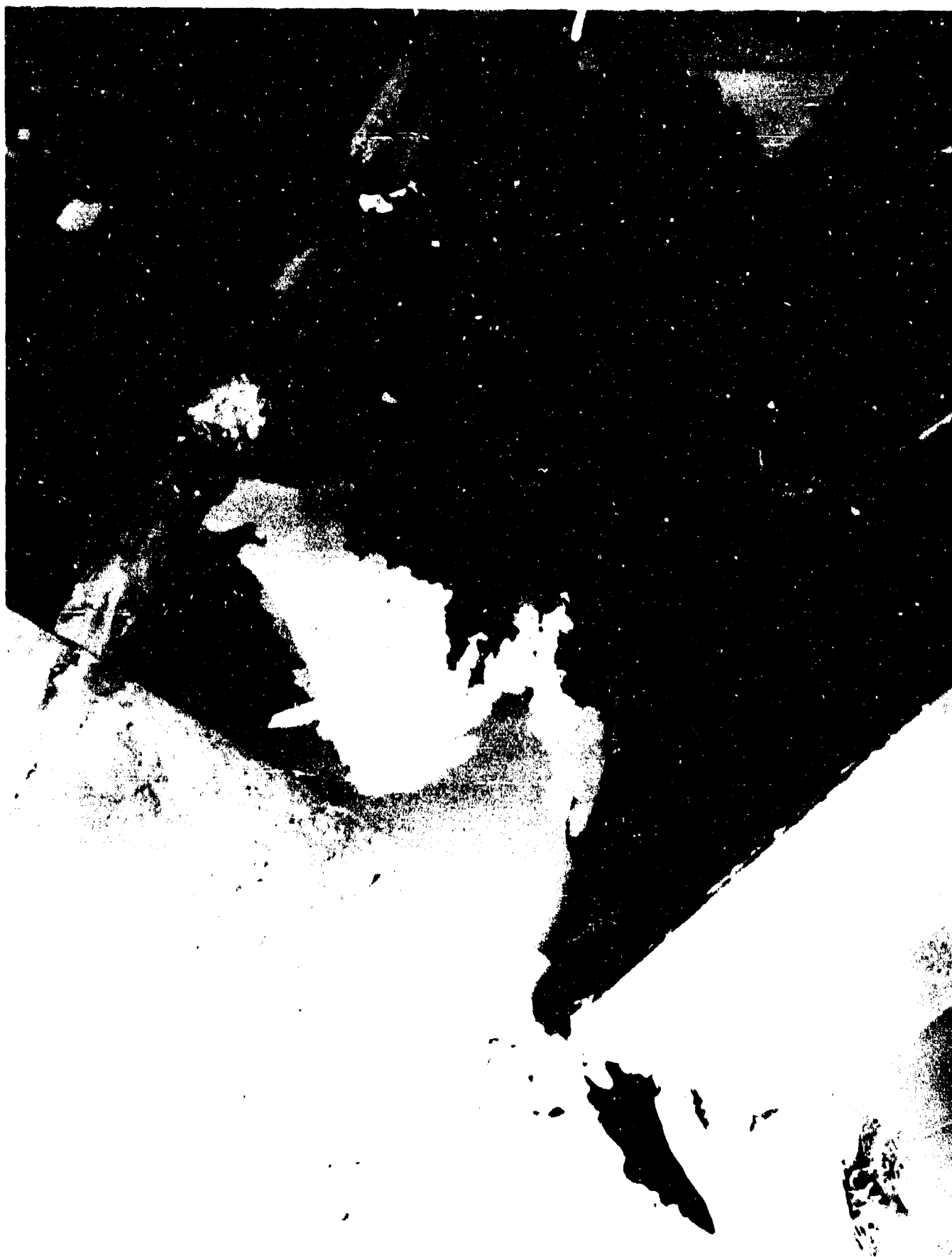
Page 59 of 211 Pages



AA-CR-68-2094-10. USS ARKANSAS (BB33). Failure in after port leg of forward tripod in way of supporting bracket for range finder platform. Looking forward and to port. Note failure at toe of weld along the web, and thru the weld across the flange.

TOP SECRET

Page 60 of 211 Pages



AA-CR-92-1783-1. USS ARKANSAS (BB33). Failure in after starboard leg of forward tripod in way of supporting brackets for range finder platform. Looking forward and up.

TOP SECRET

Page 61 of 211 Pages



AA-CR-92-1783-2. USS ARKANSAS (BB33). Failure in after port leg of forward tripod in way of supporting bracket for range finder platform. Looking forward and to port. Note failure at toe of weld along the web and thru the weld across the flange.

TOP SECRET

Page 62 of 211 Pages



AA-CR-175-2135-3. USS ARKANSAS (BB33). Starboard tripod leg showing failure in way of supporting bracket or range finder platform. Looking forward and to starboard.

TOP SECRET

Page 63 of 211 Pages



AA-CR-2146-5. USS ARKANSAS (BB33). 2nd deck, base of starboard
aft leg, frame 103.

TOP SECRET

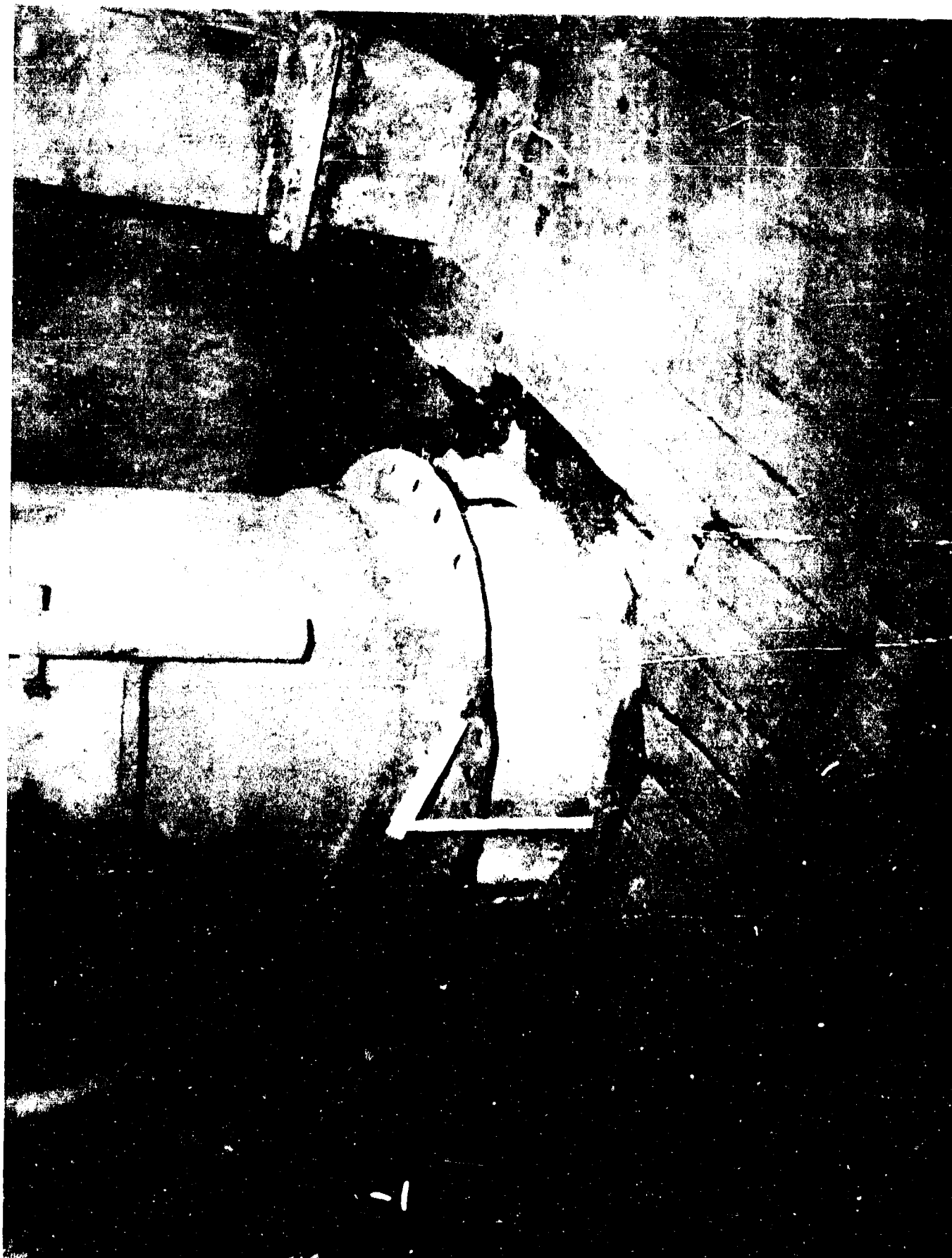
Page 64 of 211 Pages



AA-CR-68-2146-1. USS ARKANSAS (BB33). Mainmast, starboard aft leg, showing lift from deck, main deck.

TOP SECRET

Page 65 of 211 Pages



AA-CR-68-2146-1. USS ARKANSAS (BB33). Mainmast, starboard aft leg, showing lift from deck, main deck.

TOP SECRET

Page 65 of 211 Pages



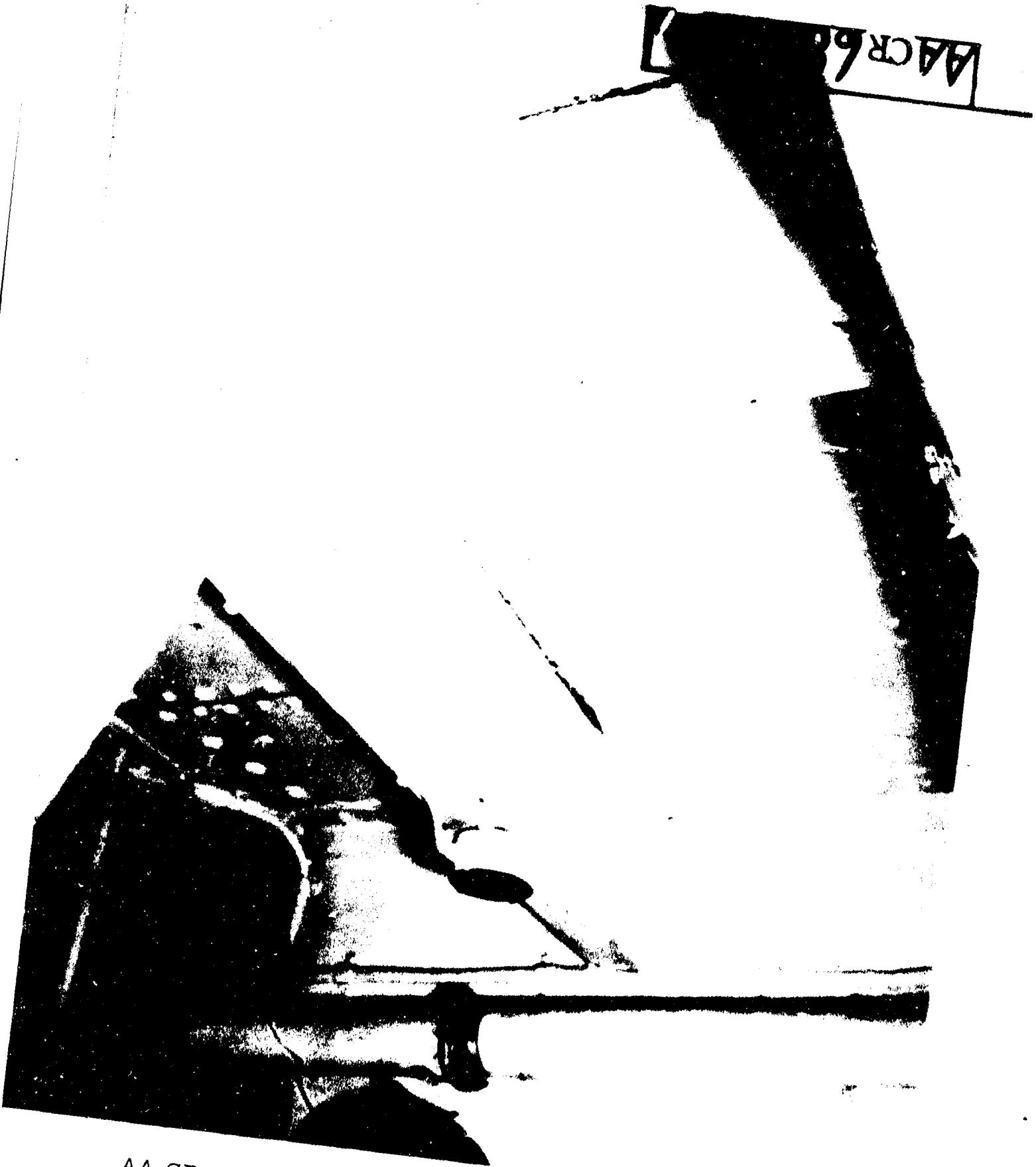
AA-CR-68-2146-1. USS ARKANSAS (BB33). Mainmast, starboard aft leg, showing lift from deck, main deck.

TOP SECRET

Page 65 of 211 Pages



AA-CR-68-2146-6. USS ARKANSAS (BB33). Starboard aft leg, frame 103, underside main deck.



AA-CR-68-2146-7. USS ARKANSAS (BB33). Starboard aft leg, frame 103, underside of main deck, showing lifting of plate from longitudinals and beams.

TOP SECRET



AA-CR-68-2111-10. USS ARKANSAS (BB33). Port aft leg above wrapper plate - Looking to starboard.

TOP SECRET

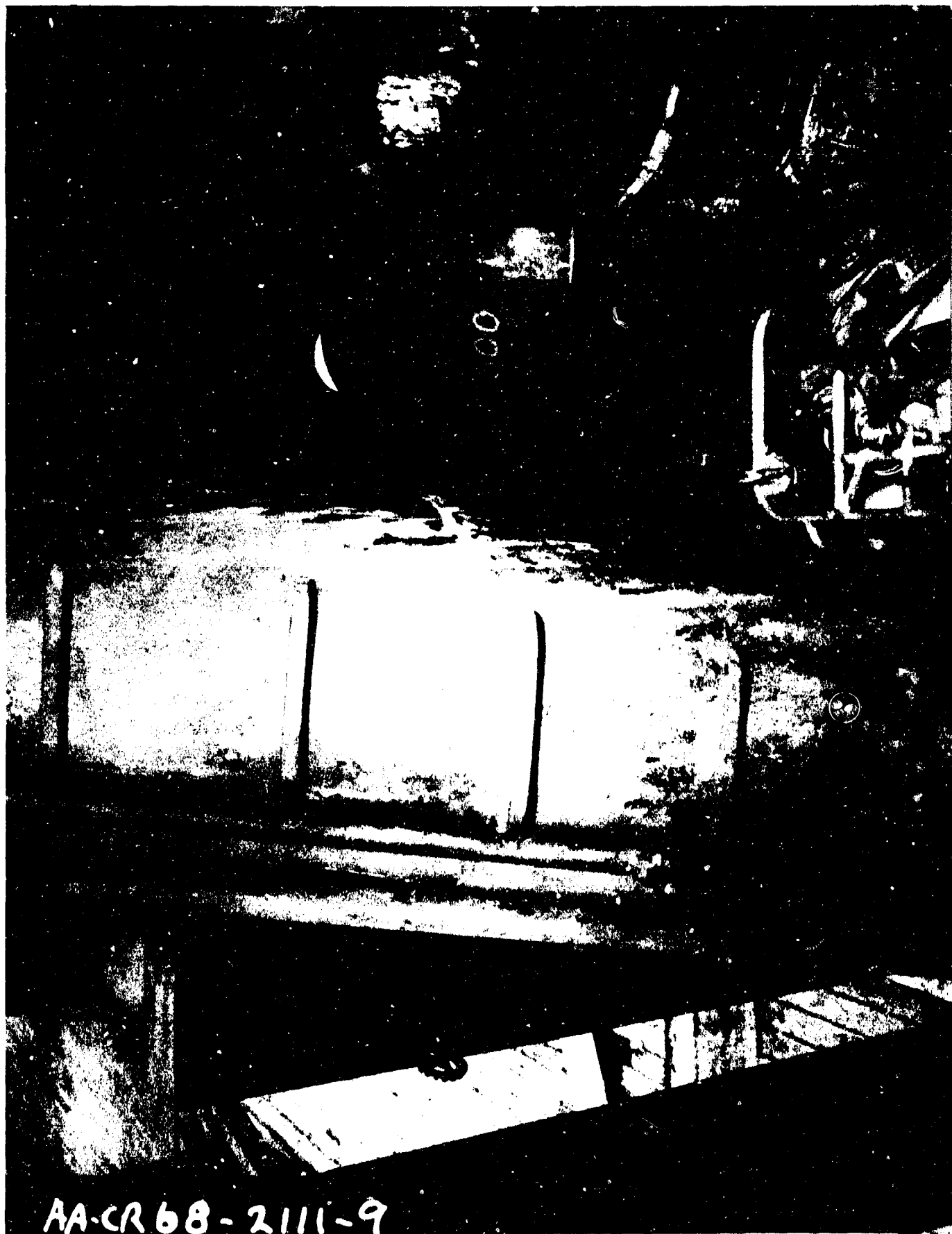
Page 68 of 211 Pages



AA-CR-175-2134-7. USS ARKANSAS (BB33). Port after leg of after tripod, looking to starboard, showing wrinkle at top of wrapper plate, see also 2111-10.

TOP SECRET

Page 69 of 211 Pages



AA-CR-68-2111-9. USS ARKANSAS (BB33). Port aft leg-mainmast showing wrinkle between leg and wrapper plate.

TOP SECRET

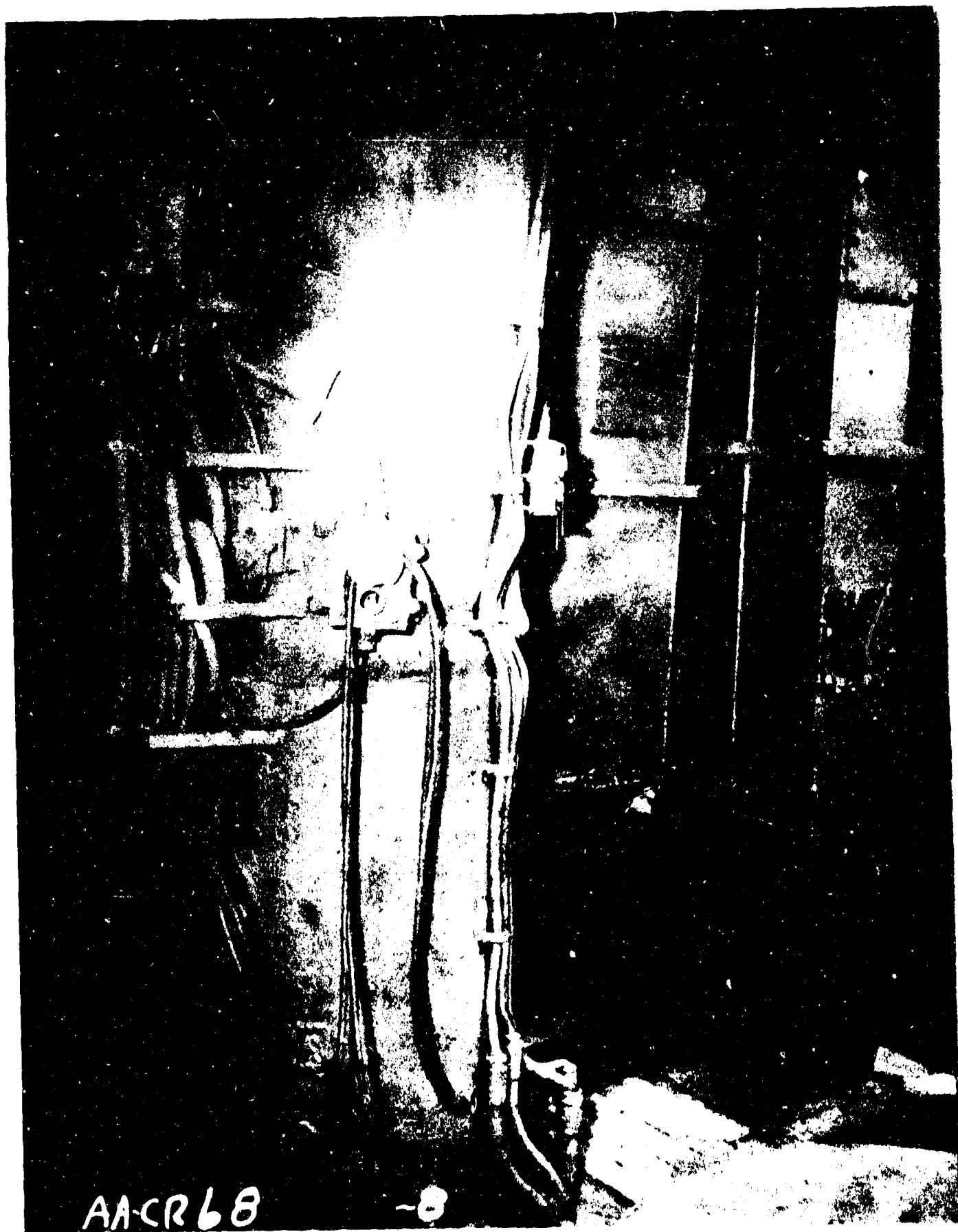
Page 70 of 211 Pages



AA-CR-68-2111-7. USS ARKANSAS (BB33). Foreleg-mainmast tripod - looking at port side, wrinkle in leg.

TOP SECRET

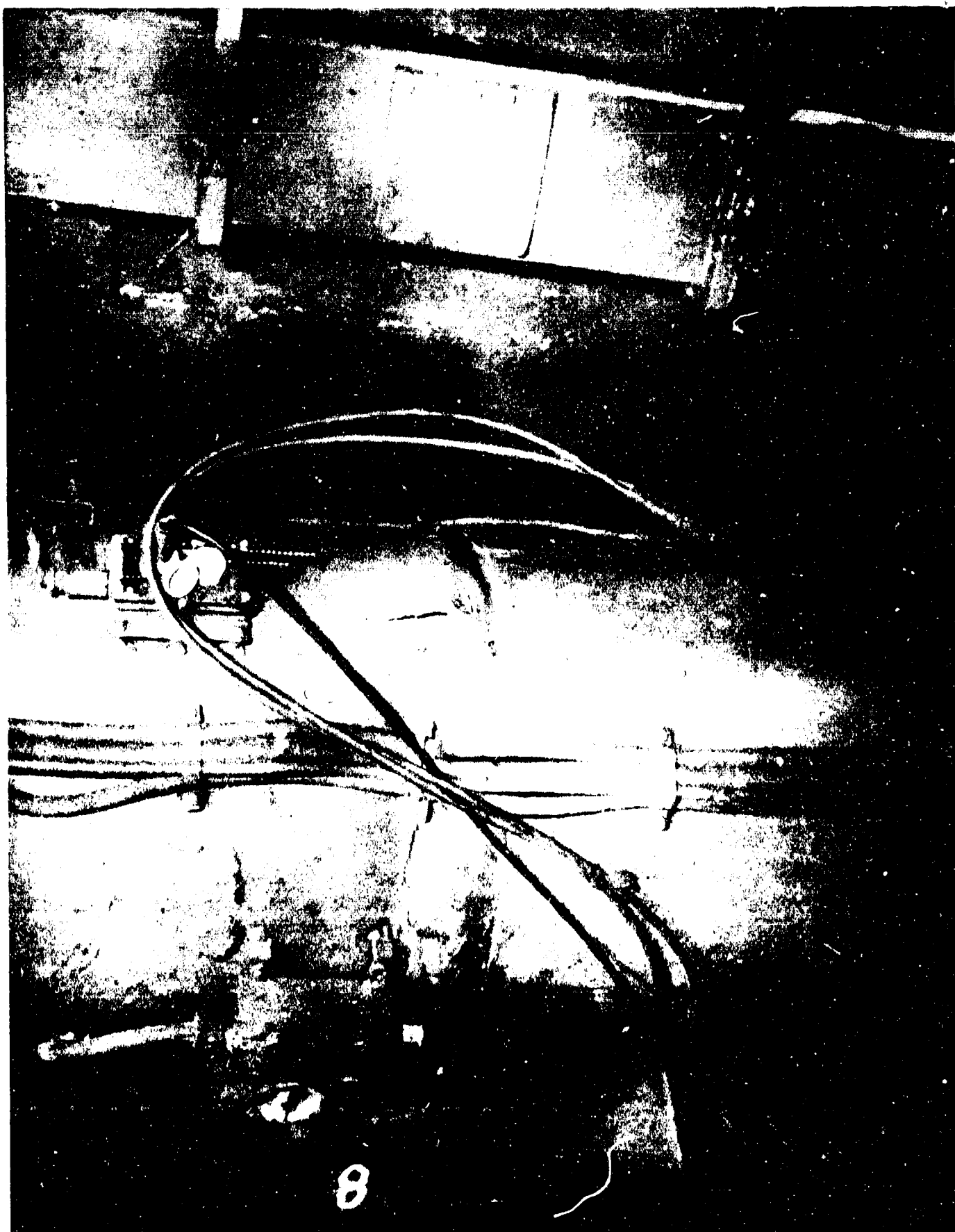
Page 71 of 211 Pages



AA-CR-68-2111-8. USS ARKANSAS (BB33). Foreleg- mainmast tripod looking at wrinkle from starboard side.

TOP SECRET

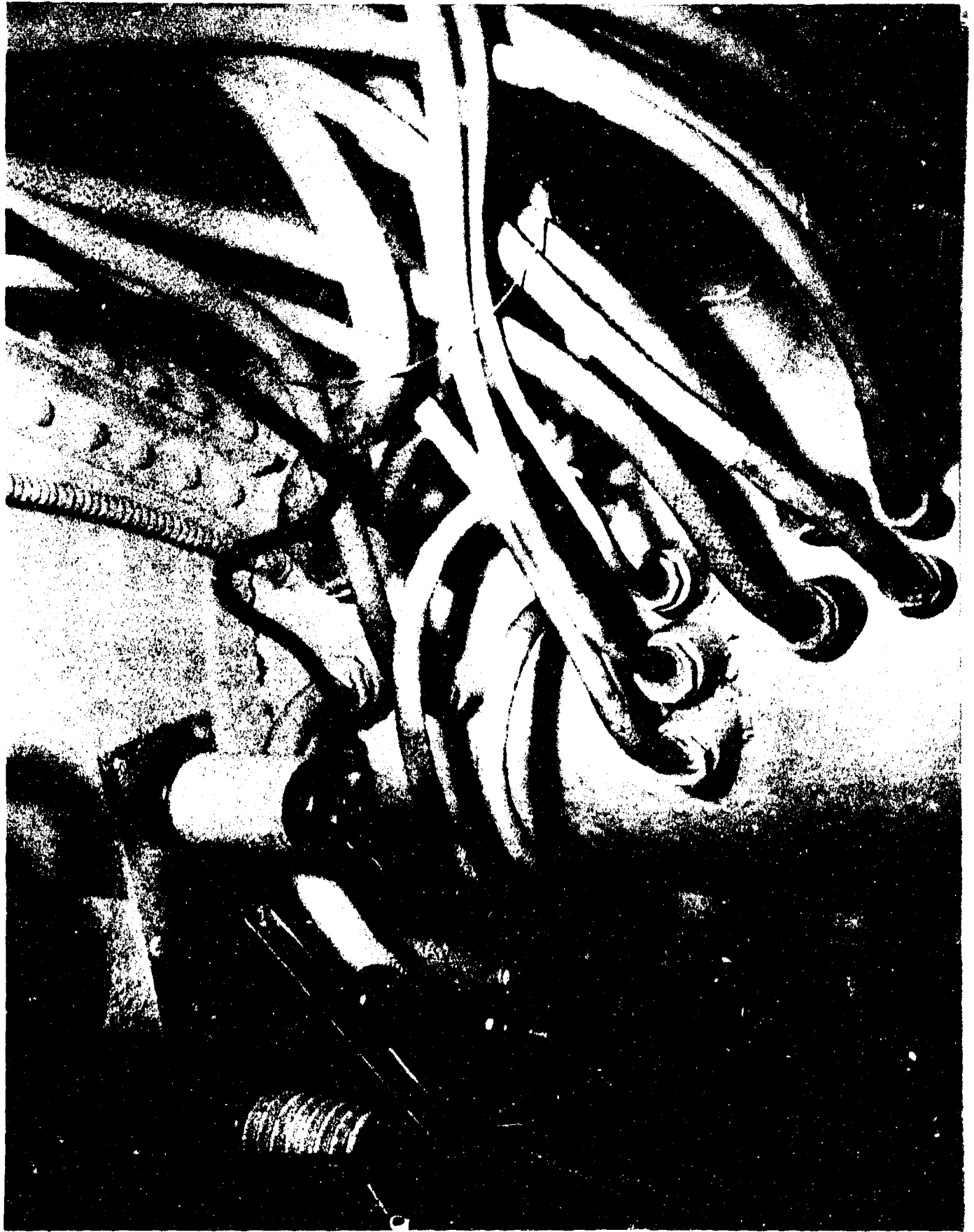
Page 72 of 211 Pages



AA-CR-175-2134-8. USS ARKANSAS (BB33). Forward leg of after tripod showing wrinkling at top of wrapper plate, and opening of beam on port side.

TOP SECRET

Page 73 of 211 Pages



AA-CR-68-2146-9. USS ARKANSAS (BB33). Center leg, after tripod, frame 99, looking aft under second deck.

TOP SECRET

Page 74 of 211 Pages



AA-CR-68-2146-10. USS ARKANSAS (BB33). Center leg, after tripod, frame 99, looking aft, under second deck.

TOP SECRET

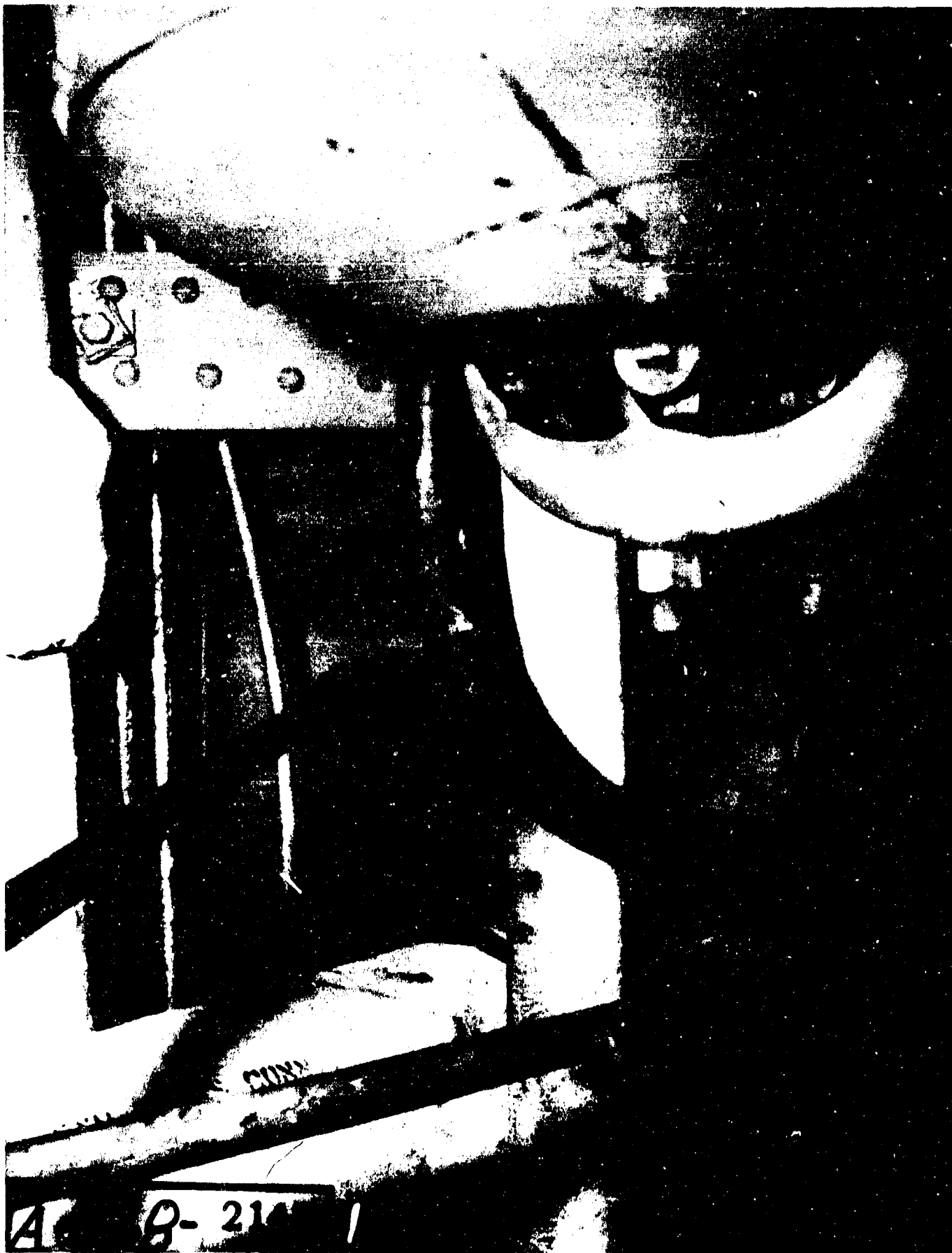
Page 75 of 211 Pages



AA-CR-68-2146-12. USS ARKANSAS (BB33). Failure of longitudinal bulkhead engine room, looking to port between frames 99 - 100.

TOP SECRET

Page 76 of 211 Pages



AA-CR-68-2147-1. USS ARKANSAS (BB33). Bulge in longitudinal bulkhead under 3rd deck - frames 98-99. Looking to starboard.

TOP SECRET

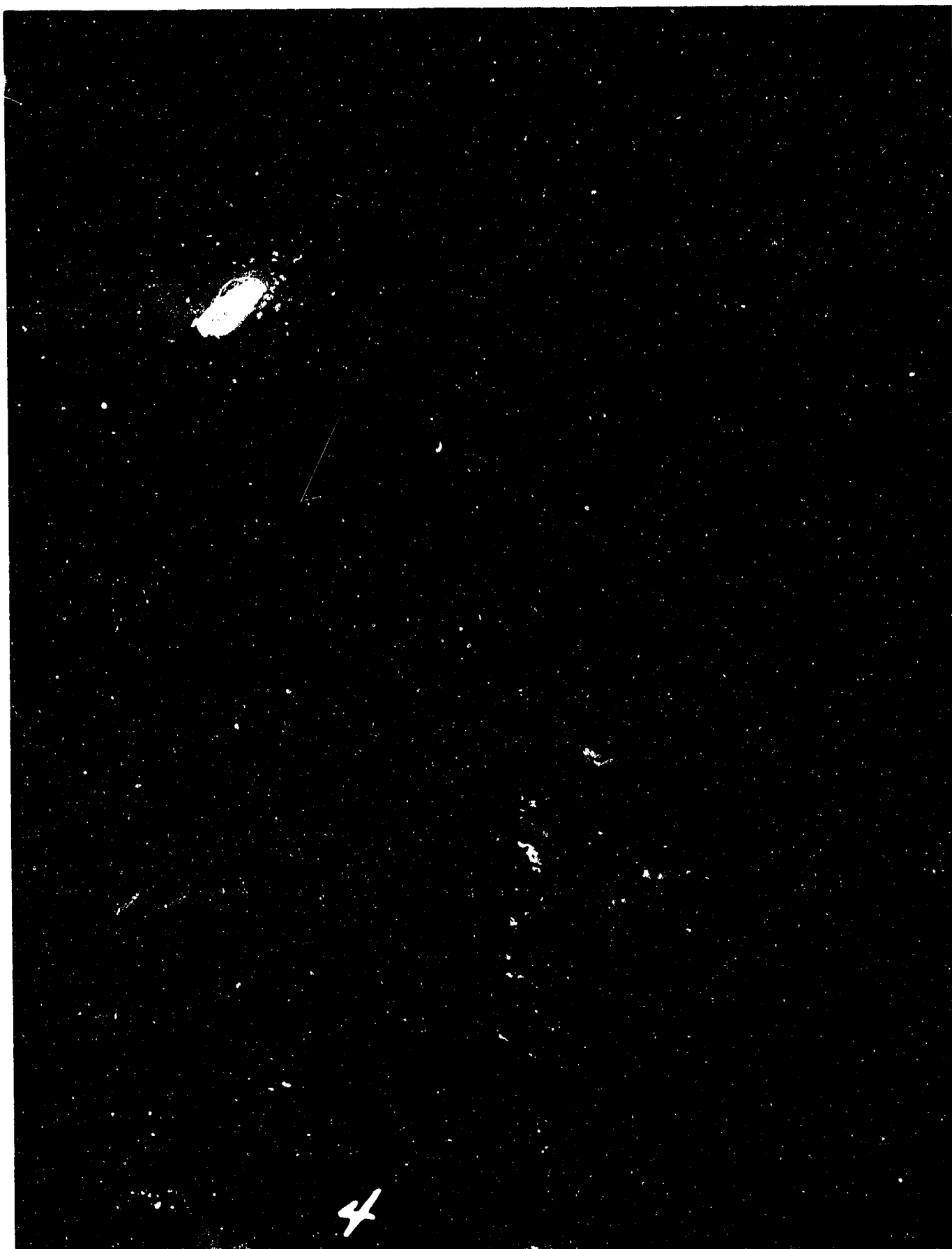
Page 77 of 211 Pages



AA-CR-92-1783. USS ARKANSAS (BB33). Starboard side of aft superstructure at frame 102, showing opening at 01 level.

TOP SECRET

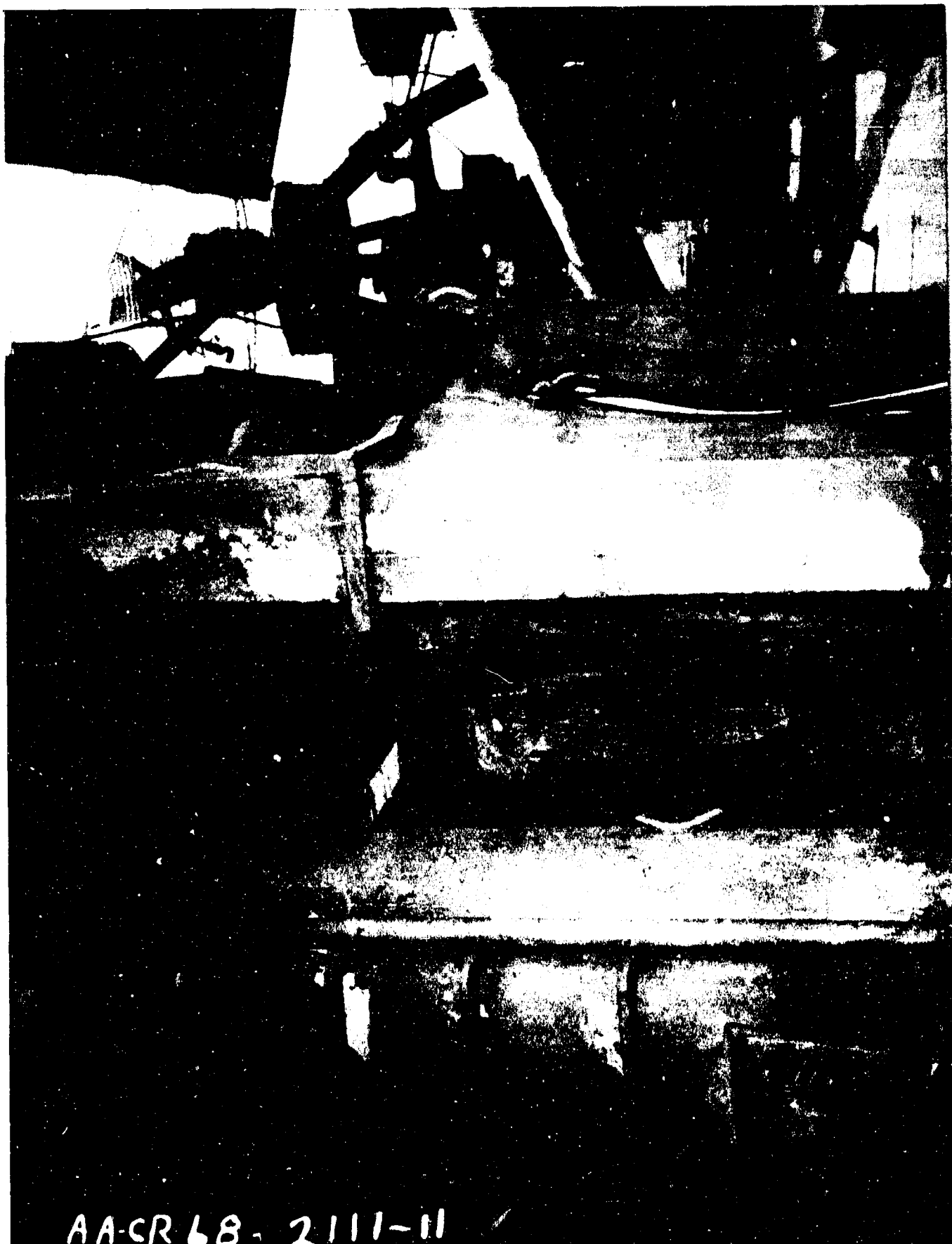
Page 78 of 211 Pages



AA-CR-92-1783-4. USS ARKANSAS (BB33). Centerline of aft superstructure at frame , showing opening at 01 level. Note tear between 01 level deck and after bulkhead.

TOP SECRET

Page 79 of 211 Pages



AA-CR-68-2111-11. USS ARKANSAS (BB33). Mainmast structure - starboard side - gap at 01 level.

TOP SECRET

Page 80 of 211 Pages



AA CR 68- 2146-1

AA-CR-68-2146-3. USS ARKANSAS (BB33). Aft starboard leg, wrinkle at 01 level.

TOP SECRET

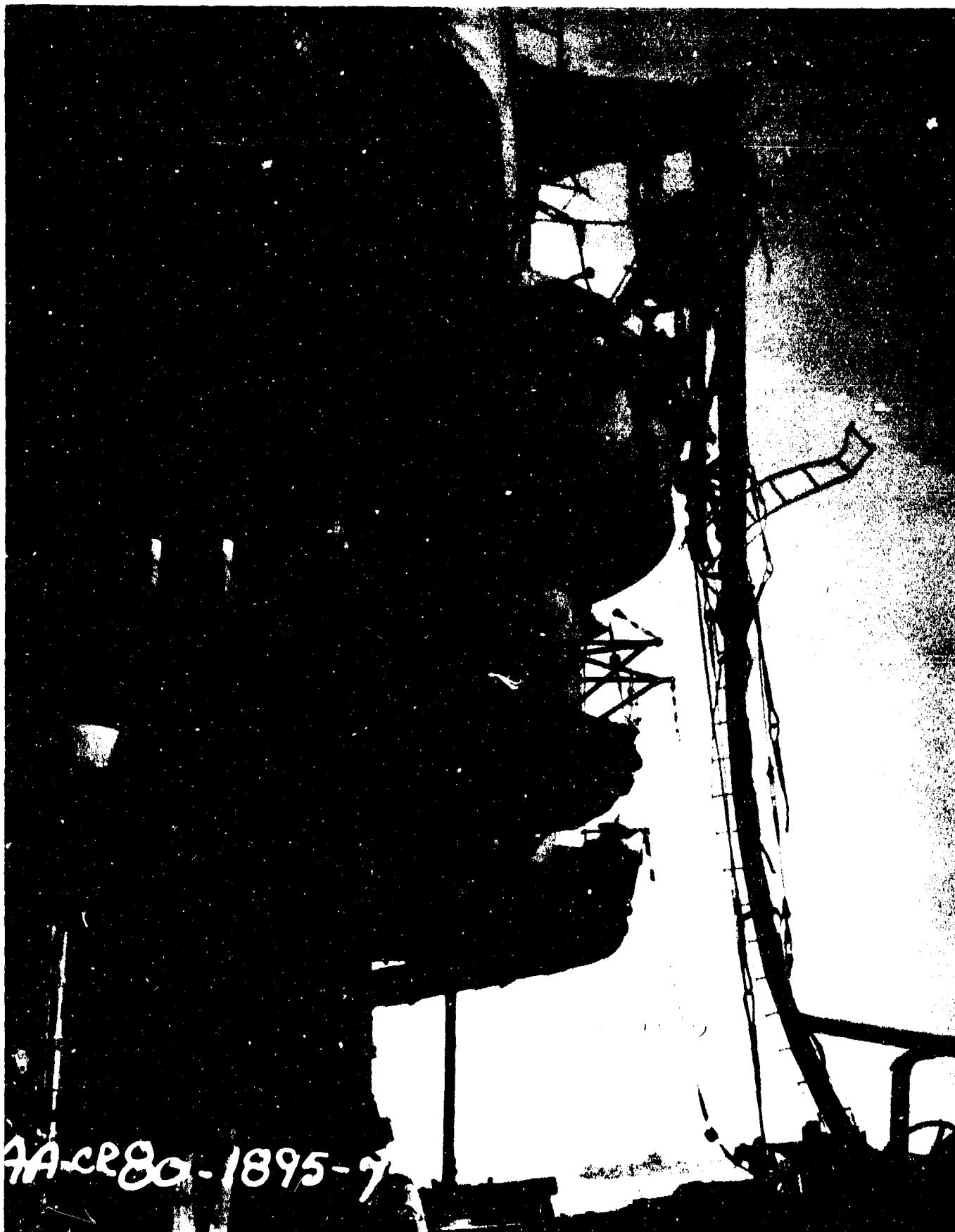
Page 81 of 211 Pages



AA-CR-68-2146-2. USS ARKANSAS (BB33). 02 level, showing crack around starboard aft leg.

TOP SECRET

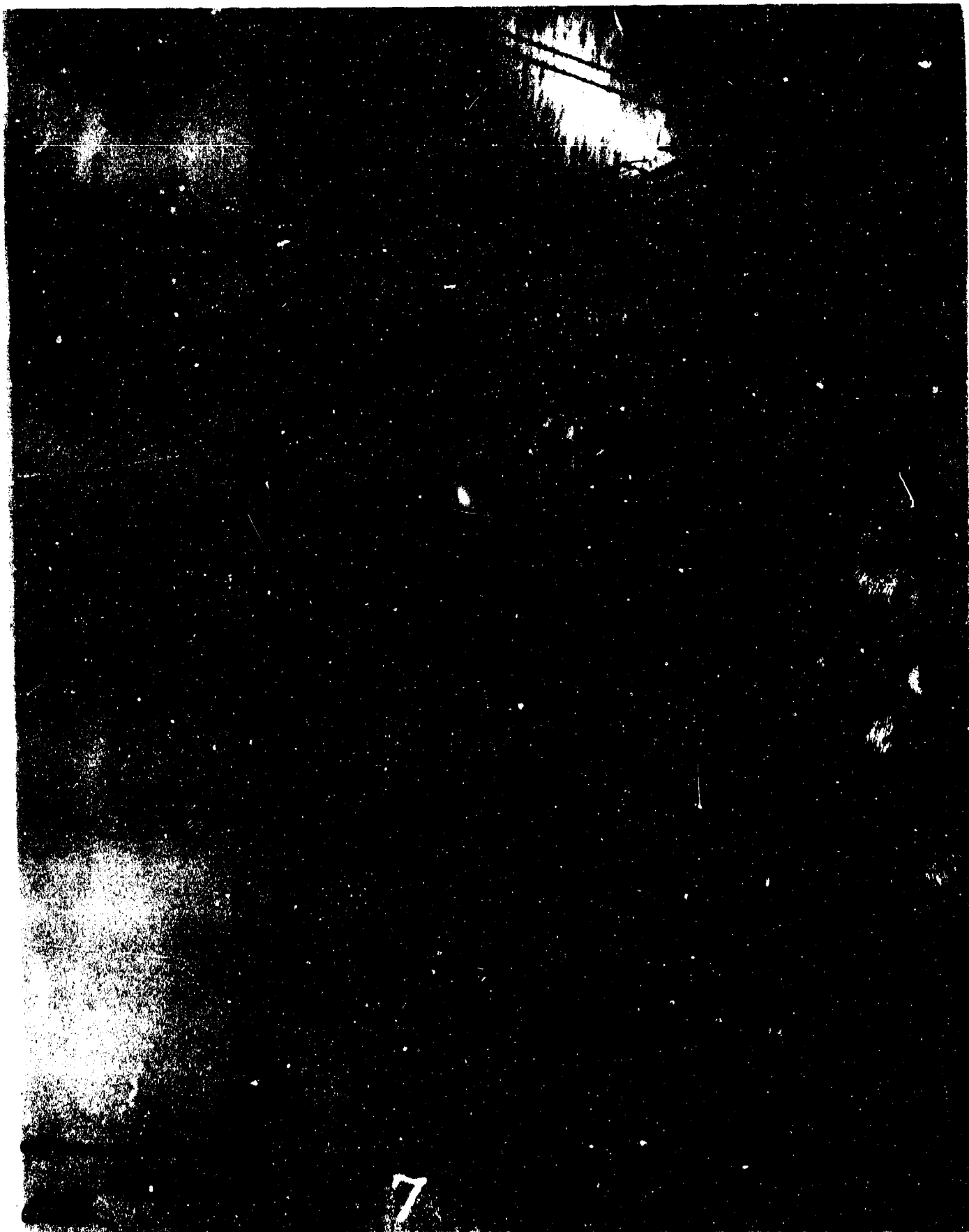
Page 82 of 211 Pages



AA-CR-80-1895-7. USS ARKANSAS (BB33). Forward area of after tripod, looking to port, showing main mast hanging top down.

TOP SECRET

Page 83 of 211 Pages



AA-CR-175-2135-7. USS ARKANSAS (BB33). General view aft. Remains of pole mainmast support can be seen just forward of after main director.

TOP SECRET

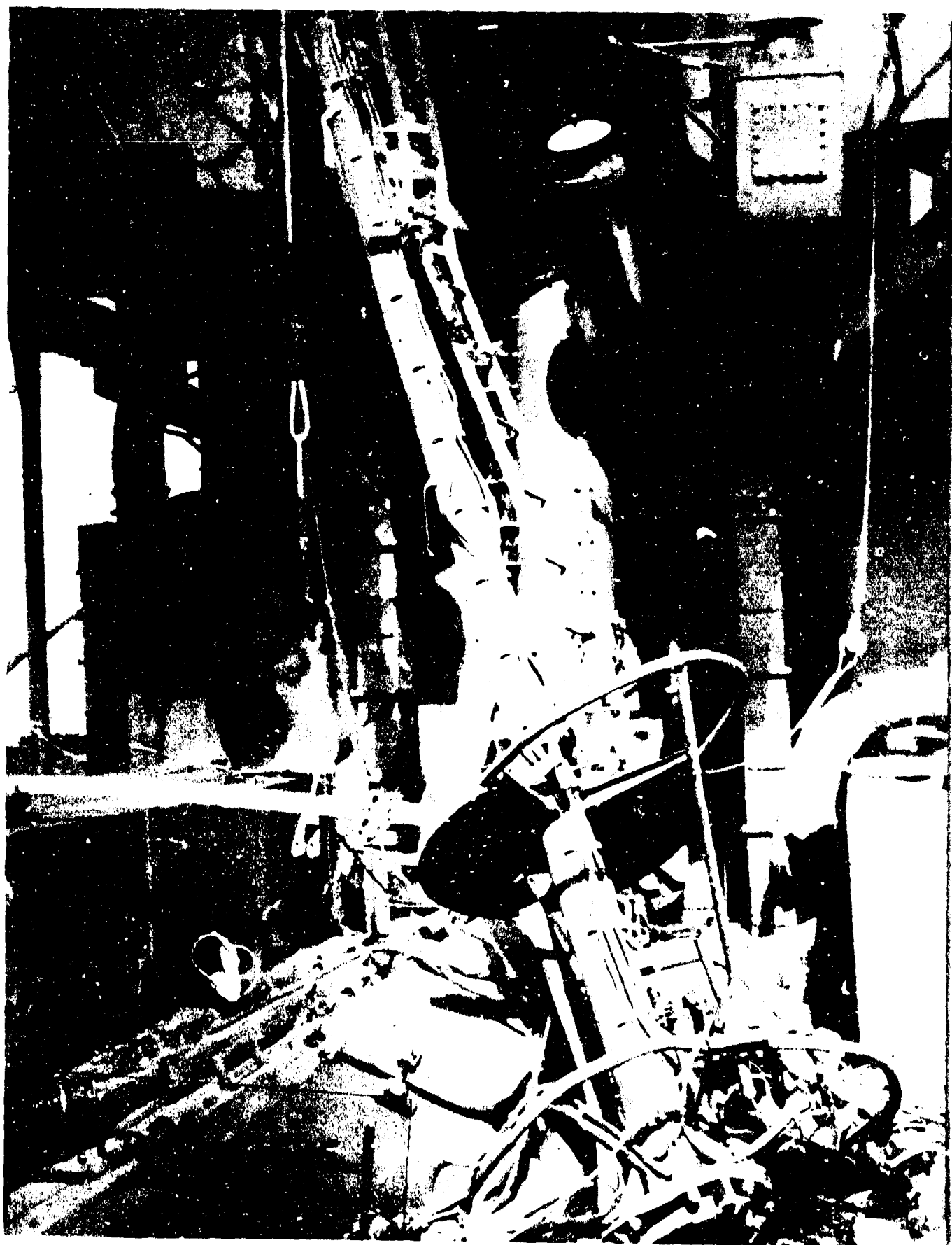
Page 84 of 211 Pages



AA-CR-92-1775-12. USS ARKANSAS (BB33). Looking from starboard toward mainmast structure. Showing failure of maintopmast.

TOP SECRET

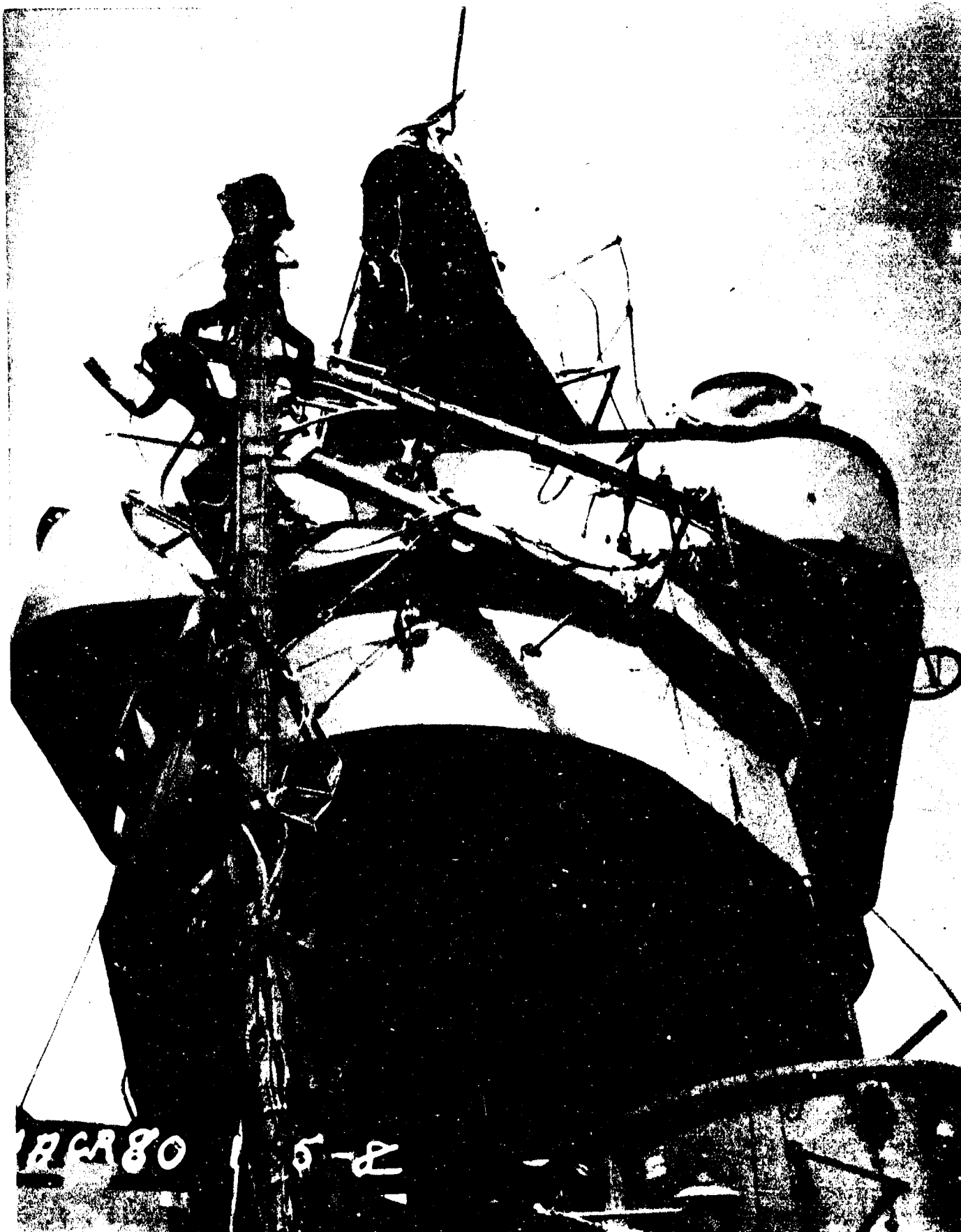
Page 85 of 211 Pages



AA-CR-80-1895-9. USS ARKANSAS (BB33). Detail of top of mainmast.

TOP SECRET

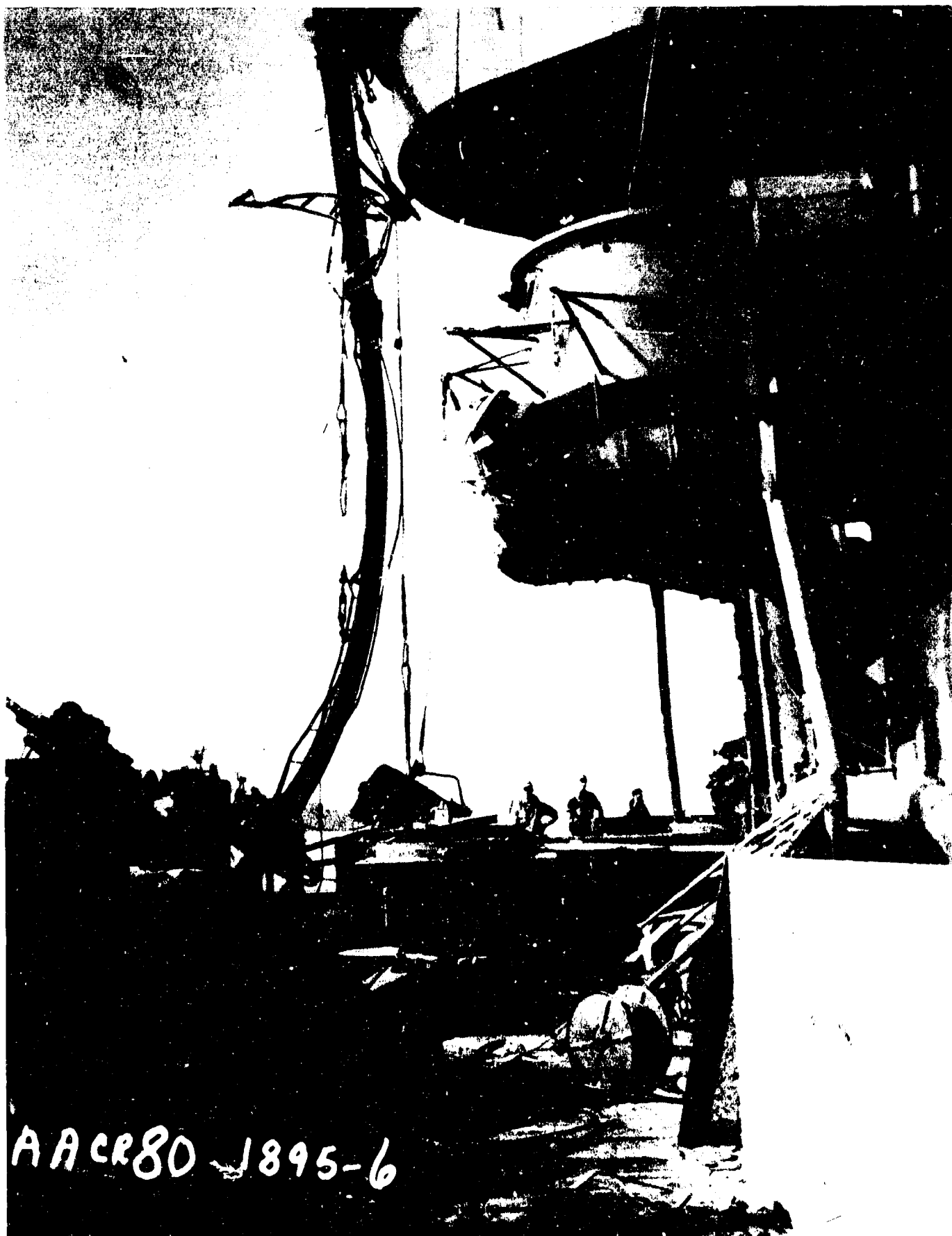
Page 86 of 211 Pages



AA-CR-80-1895-8. USS ARKANSAS (BB33). Detail of lower end of mainmast and yardarm.

TOP SECRET

Page 87 of 211 Pages



AA-CR-80-1895-6. USS ARKANSAS (BB33). General view of main deck and portion of main mast. Note that top of mast is in debris on deck.

TOP SECRET

Page 88 of 211 Pages



AA-CR-80-1895-10. USS ARKANSAS (BB33). Detail of base plate and yardarm brackets - mainmast.

TOP SECRET

Page 89 of 211 Pages



BA-CR-196-151-10. USS NEVADA (BB36). 10 June 1946. View looking at port bow.

TOP SECRET

Page 90 of 211 Pages



AA-CR-227-91-75. USS NEVADA (BB36). View looking at port bow after Test A.

TOP SECRET

Page 91 of 211 Pages



BA-CR-196-151-15. USS NEVADA (BB36). View of port beam before Test A.

TOP SECRET

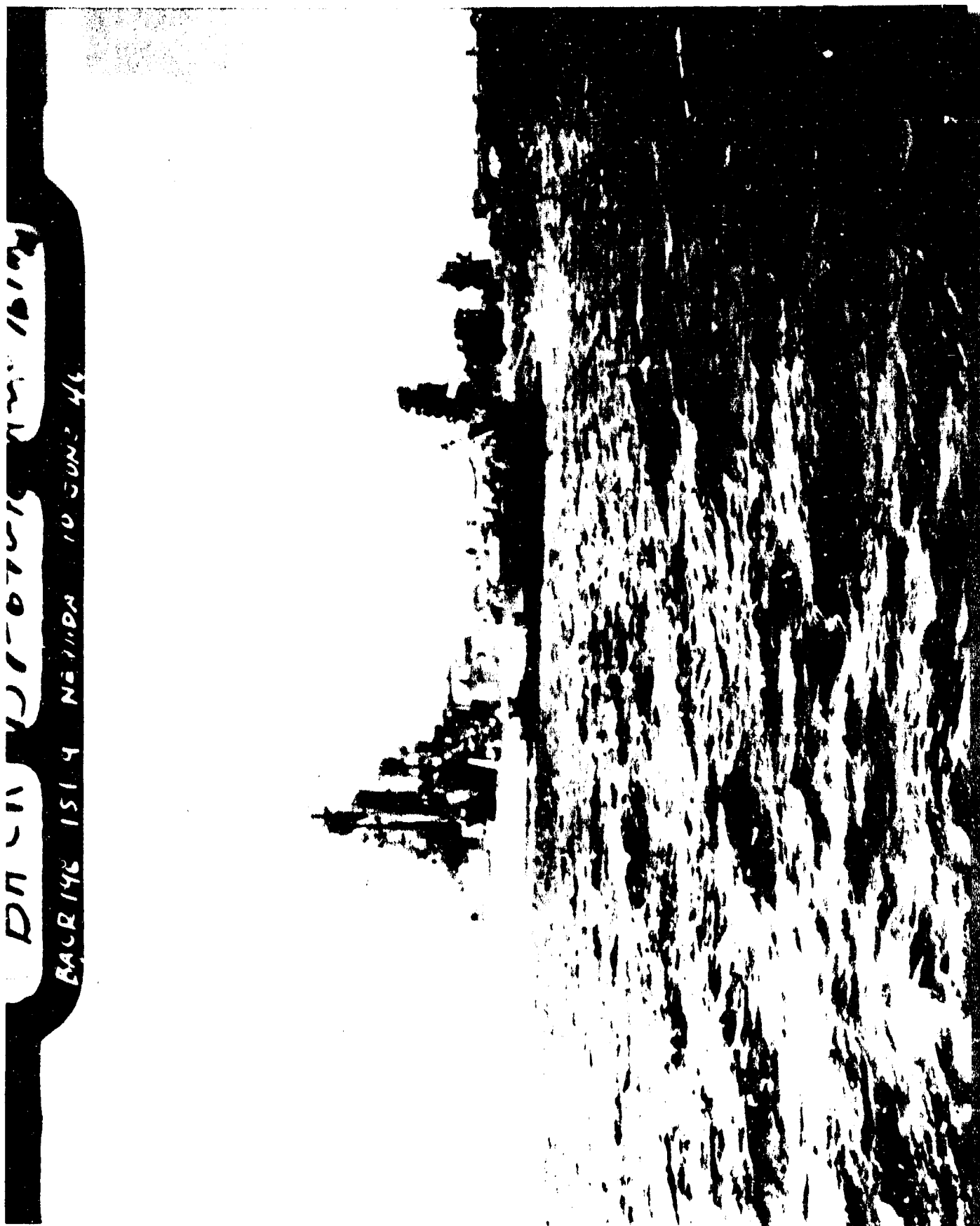
Page 92 of 211 Pages



AA-CR-227-91-74. USS NEVADA (BB36). View of port beam after Test A

TOP SECRET

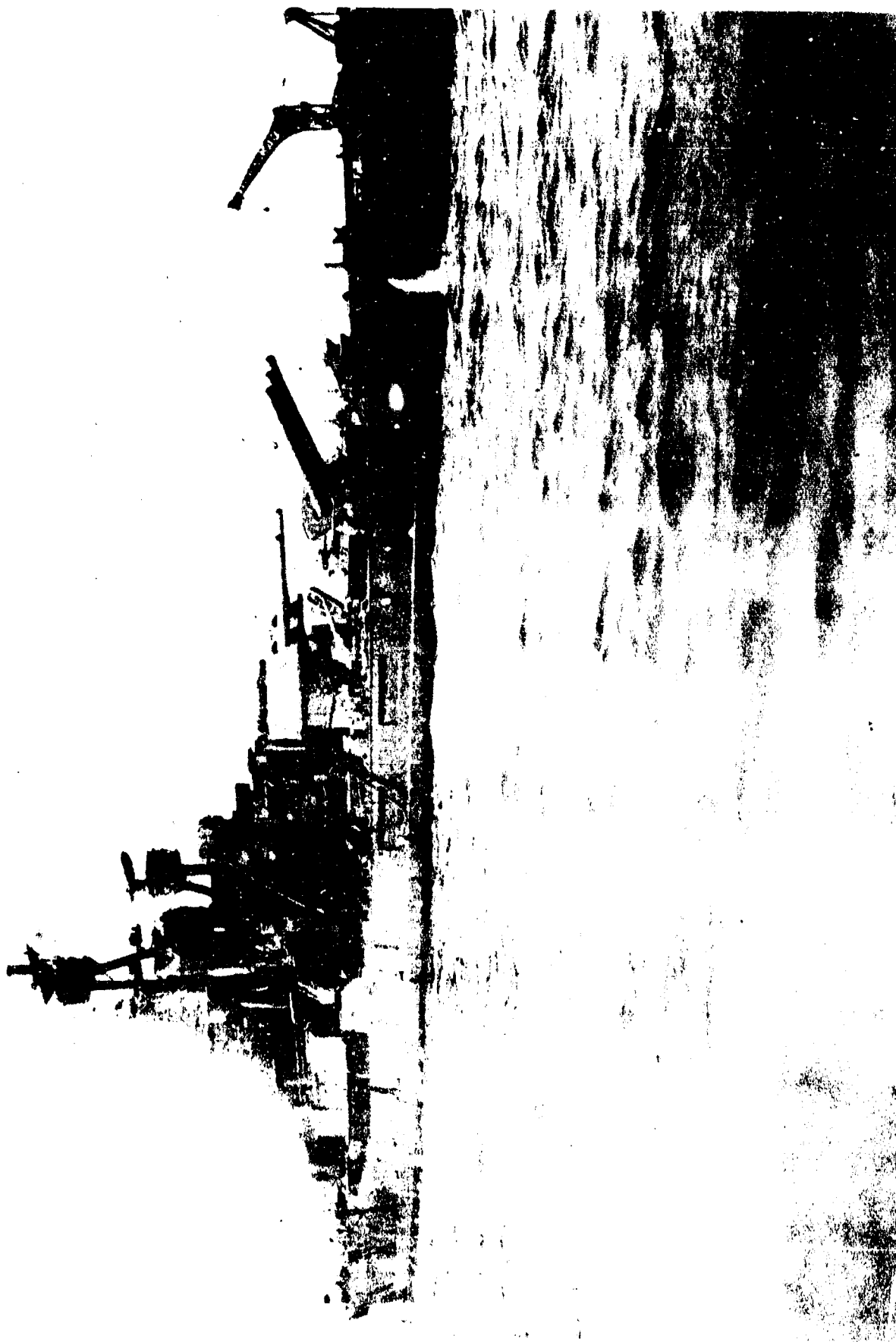
Page 93 of 211 Pages



BA-CR-196-151-9. USS NEVADA (BB36). Port quarter before Test A.

TOP SECRET

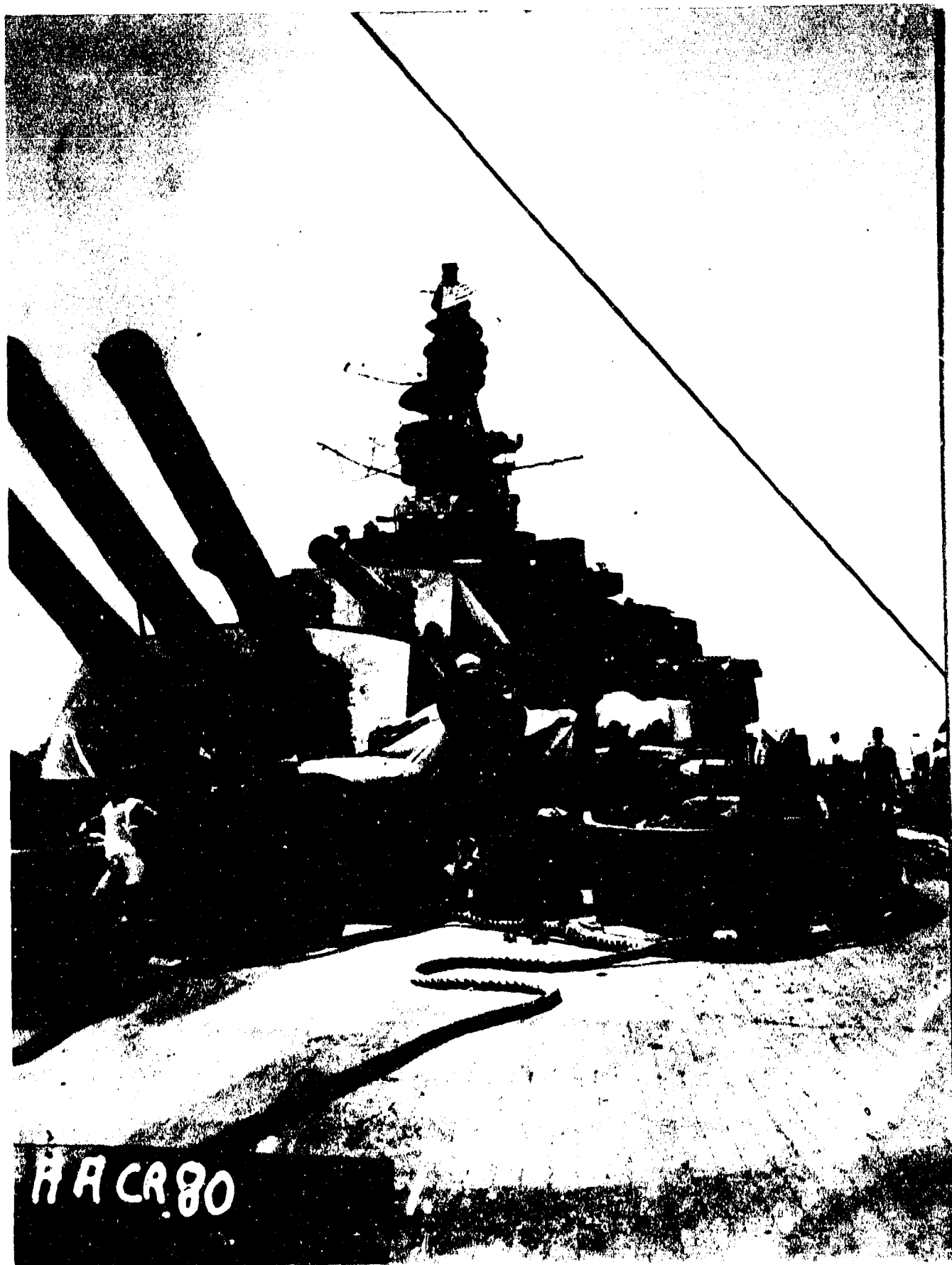
Page 94 of 211 Pages



AA-CR-227-91-73. USS NEVADA (BB36). Port quarter after Test A.

TOP SECRET

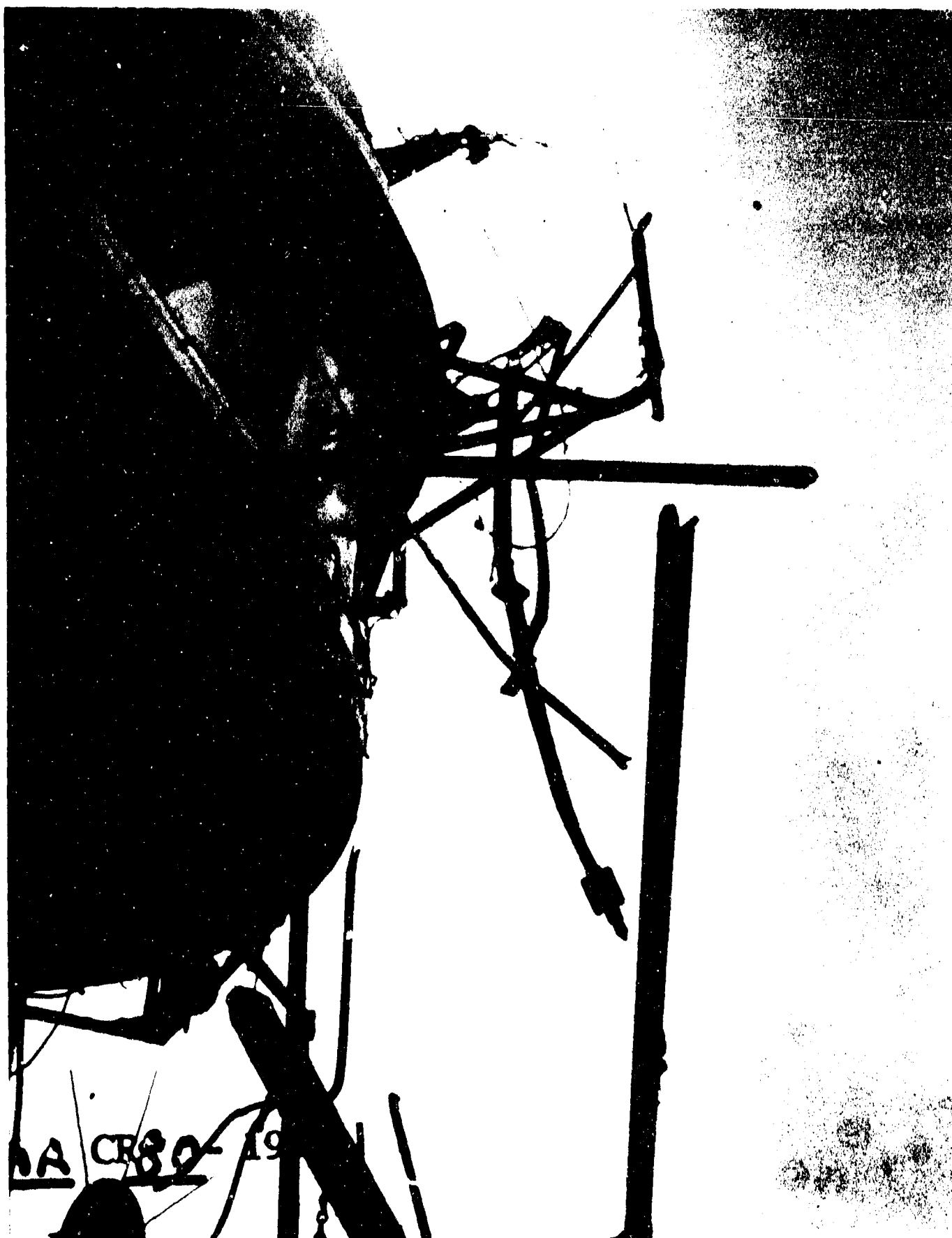
Page 95 of 211 Pages



AA-CR-80-1909-1. USS NEVADA (BB36). Looking forward, showing after and forward tripod yardarms, and remains of forward starboard yardarms.

TOP SECRET

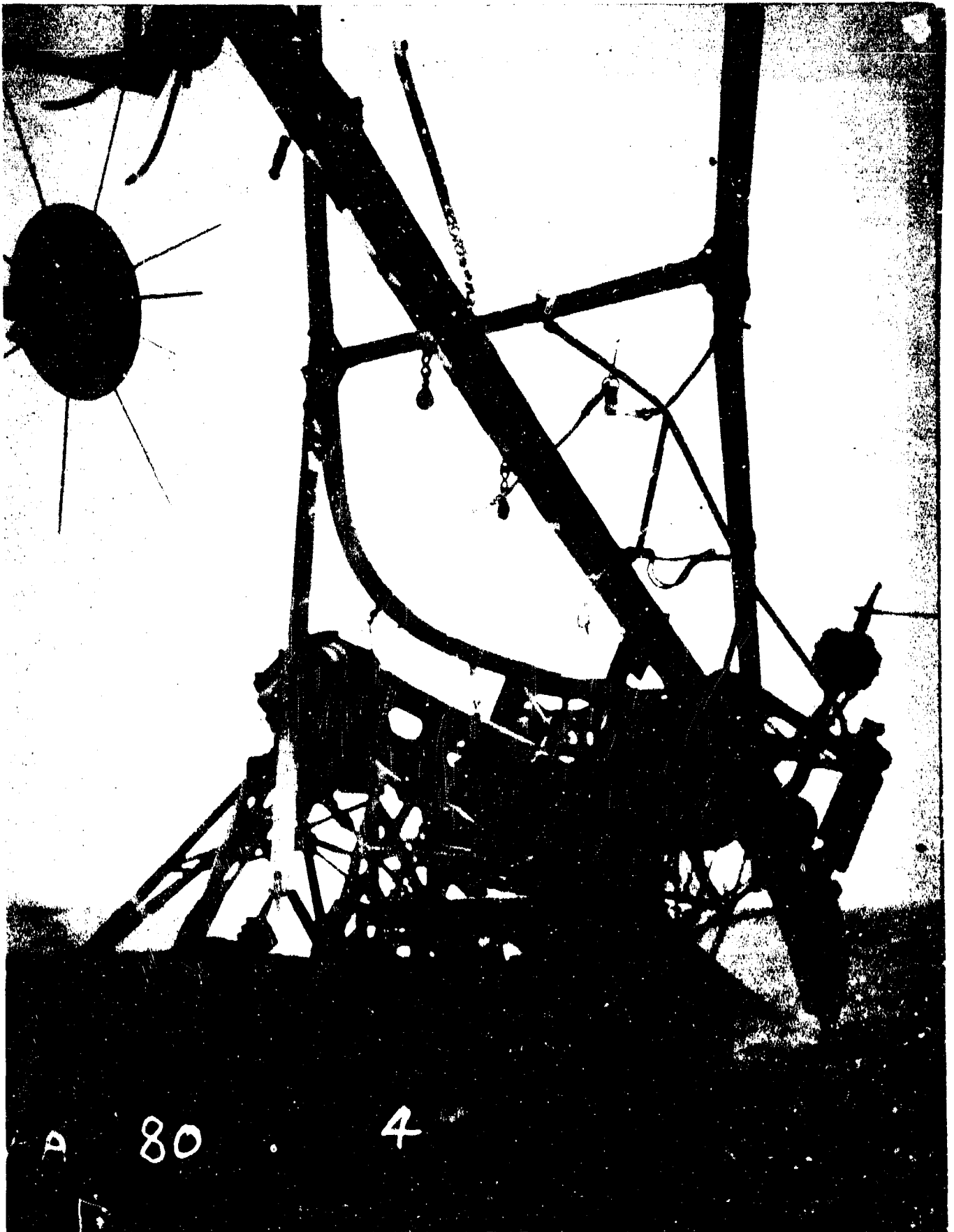
Page 96 of 211 Pages



AA-CR-80-1900-3. USS NEVADA (BB36). Forward tripod, remains of starboard yardarm.

TOP SECRET

Page 97 of 211 Pages



AA-CR-80-1900-4. USS NEVADA (BB36). Forward tripod, view looking forward at wreckage of starboard yardarm. Main member, truss and forward strut.

TOP SECRET

Page 98 of 211 Pages



AA-CR-175-2137-9

AA-CR-175-2137-9. USS NEVADA (BB36). Port leg of main tripod, frame 69, looking aft, showing crack in leg just above weld 02 level.

TOP SECRET

Page 99 of 211 Pages



AA-CR-80-1900-6. USS NEVADA (BB36). Forward tripod. Port leg.
Looking forward.

TOP SECRET

Page 100 of 211 Pages



AA-CR-175-2137-12. USS NEVADA (BB36). Starboard leg of forward tripod, looking aft, showing rumple in flange of longitudinal. Slight leg at this point. Underside of 02 level.

TOP SECRET

Page 101 of 211 Pages



AA-CR-175-2154-3. USS NEVADA (BB36). Port leg of forward tripod looking aft and slightly outboard showing crumple in lower flange of longitudinal and slight dish in leg at this point.

TOP SECRET

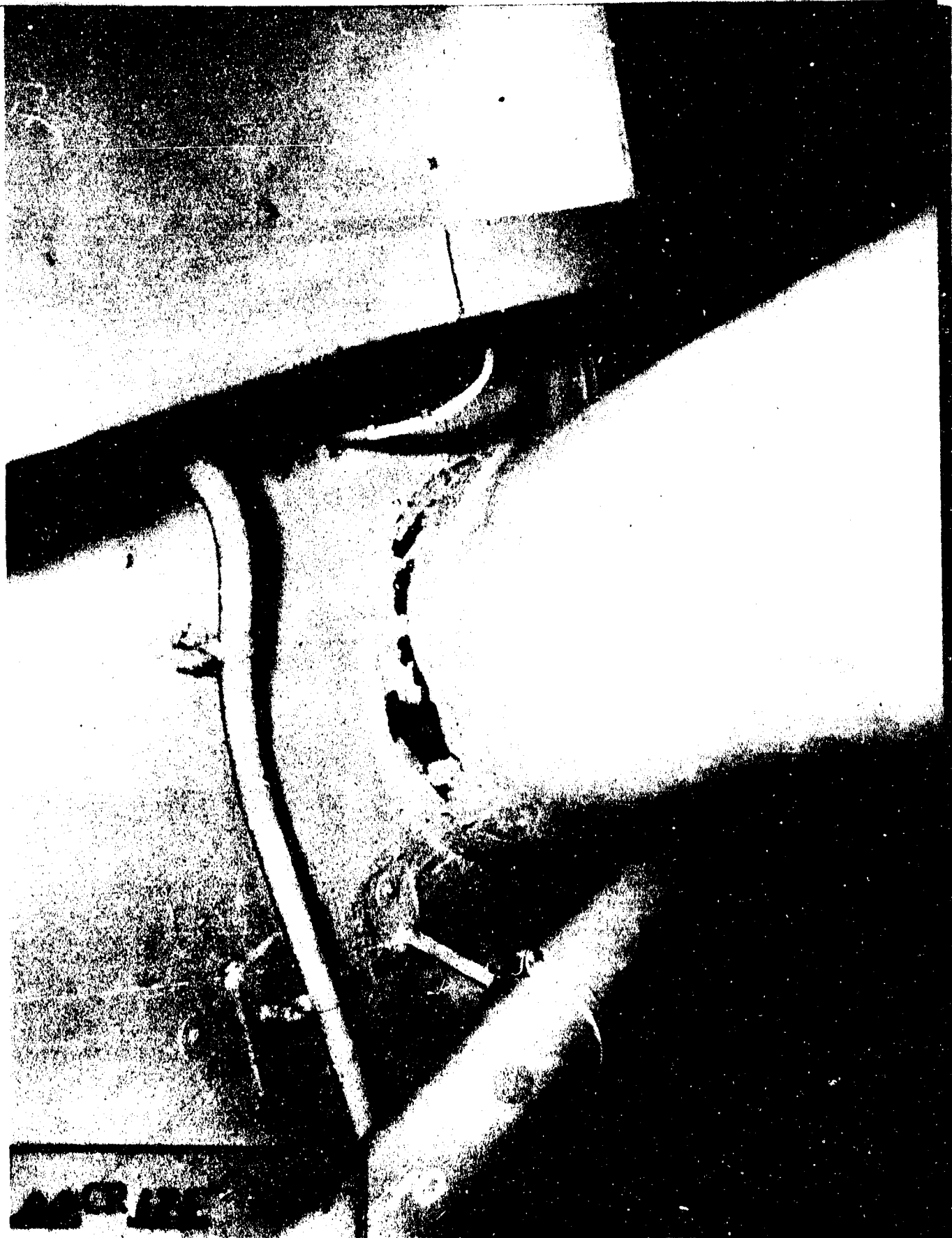
Page 102 of 211 Pages



AA-CR-175-2137-8. USS NEVADA (BB36). Outboard after leg of the starboard gun tub at frame 73, on 02 level. Note that deck is pulled up by leg.

TOP SECRET

Page 103 of 211 Pages



AA-CR-175-2137-10. USS NEVADA (BB36). Forward leg of starboard director tub, frame 68-69, looking inboard and slightly aft. Showing compression evidence at top of leg under 02 level and twist in beam at frame 68.

TOP SECRET

Page 104 of 211 Pages



AA-CR-175-2137-10. USS NEVADA (BB36). Forward leg of starboard director tub, frame 68-69, looking inboard and slightly aft. Showing compression evidence at top of leg under 02 level and twist in beam at frame 68.

TOP SECRET

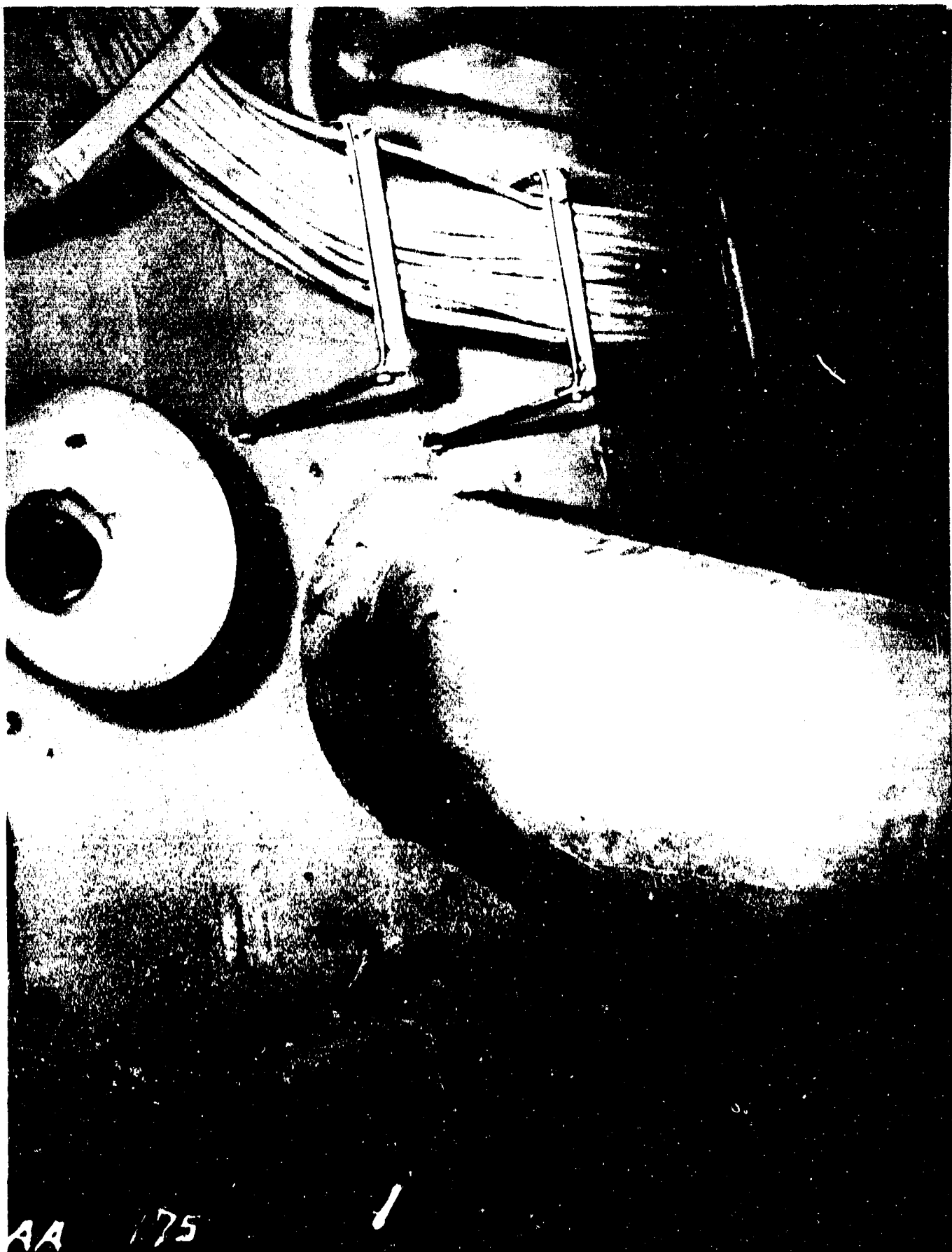
Page 104 of 211 Pages



AA-CR-175-2137-11. USS NEVADA (BB36). Forward leg of starboard director tub, frame 68-69, looking aft and outboard. Showing compression evidence at top of leg under 02 level.

TOP SECRET

Page 105 of 211 Pages



AA-CR-175-2154-1. USS NEVADA (BB36). Forward leg of port director tub, frame 68-69, looking inboard, showing compression evidence at top of leg under 02 level.

TOP SECRET

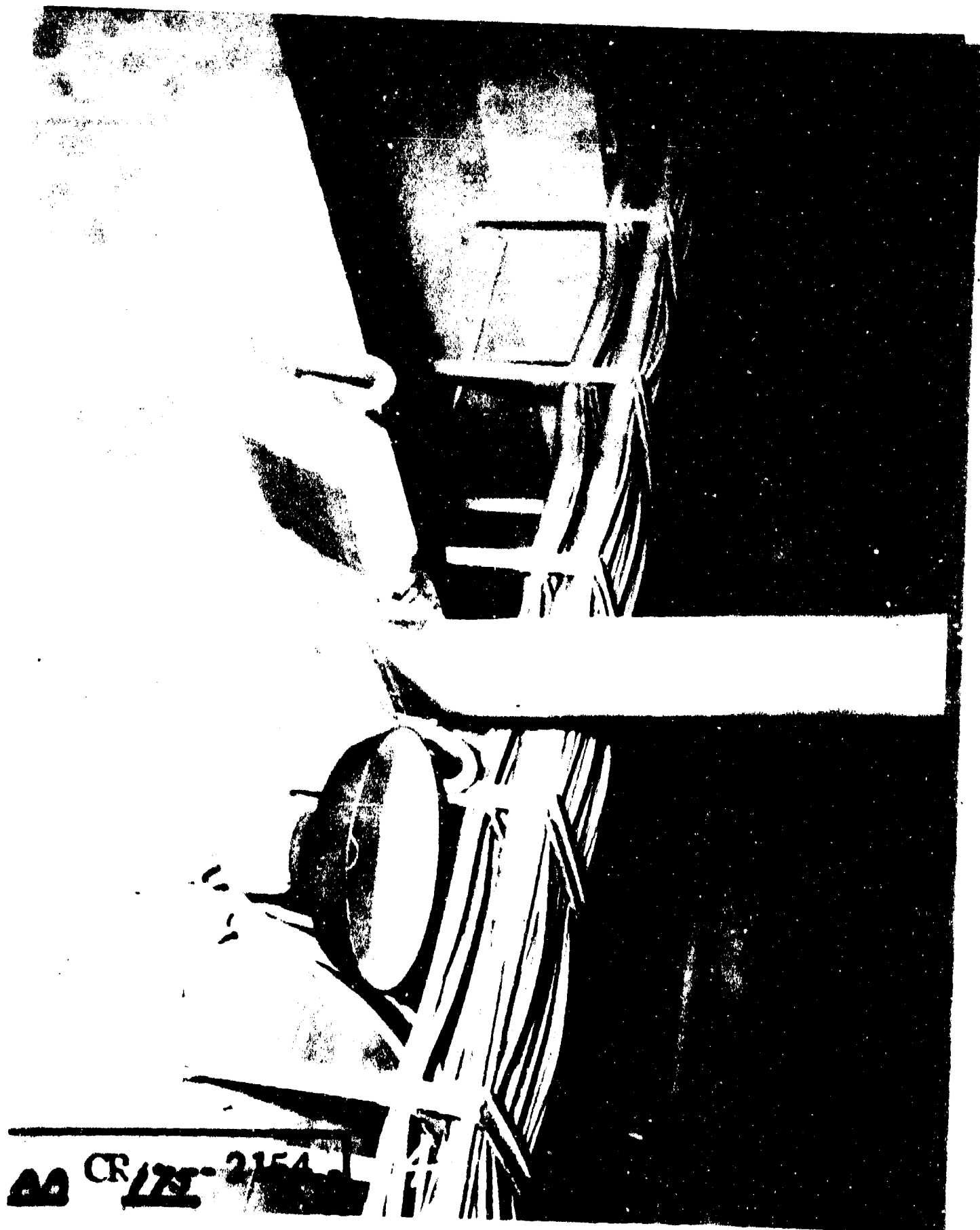
Page 106 of 211 Pages



AA-CR-175-2154-2. USS NEVADA (BB36). Forward leg of port director tub, frame 68-69, looking up and slightly outboard.

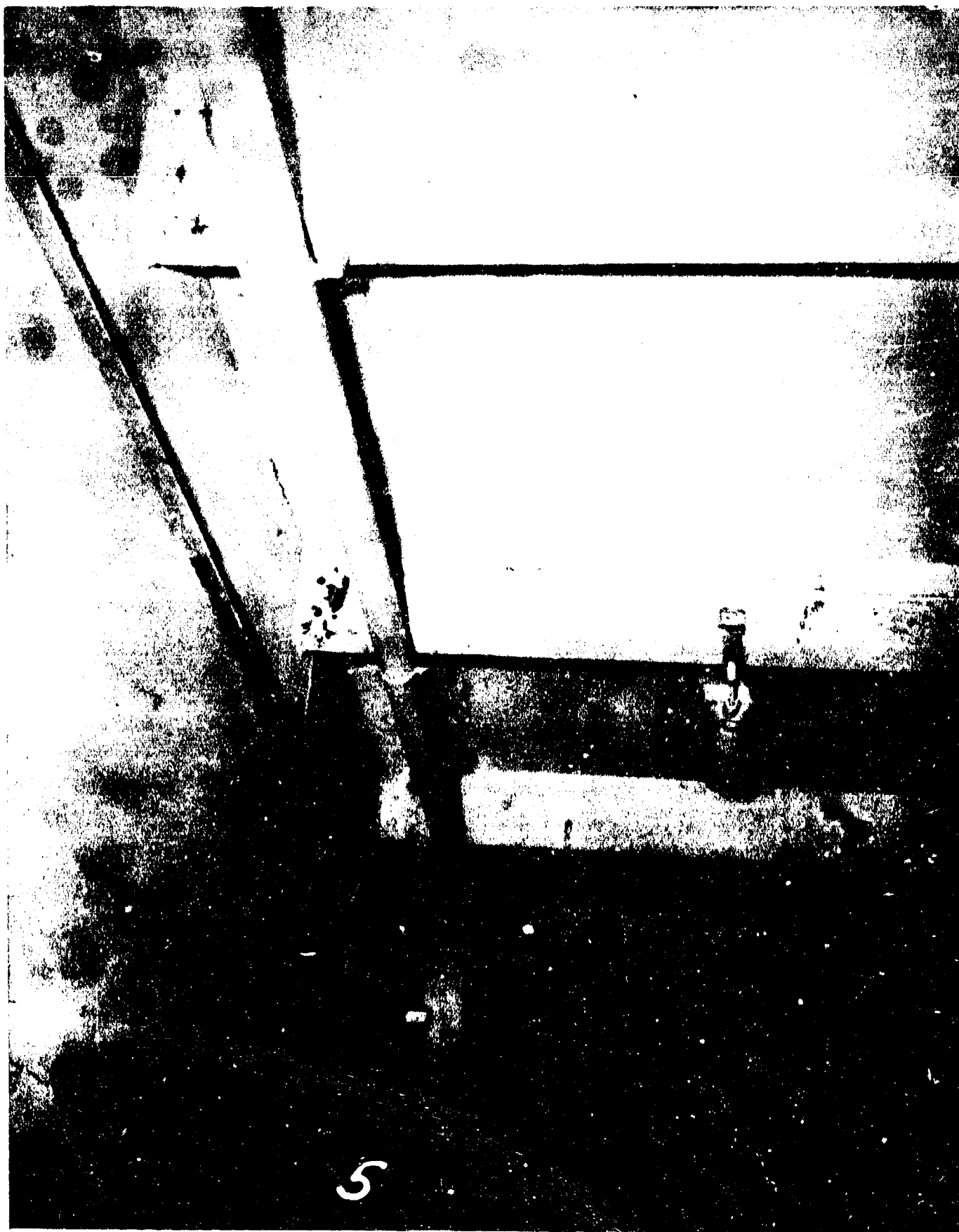
TOP SECRET

Page 107 of 211 Pages



AA-CR-175-2154-4. USS NEVADA (BB36). Stanchion 16 feet aft of centerline at frame 66 under 02 level starboard side, looking inboard, showing tipping of beam and deformation of stanchion.

TOP SECRET



AA-CR-175-2154-5. USS NEVADA (BB36). Deck beams under 02 level frame 66-67 and 68, at longitudinal bulkhead 8 feet off centerline to starboard, looking aft.

TOP SECRET

Page 109 of 211 Pages



AA-CR-175-2154-6. USS NEVADA (BB36). Deck beams under 02 level frames 64, 65 and 66, at longitudinal bulkhead 8 feet off centerline to port, looking aft.

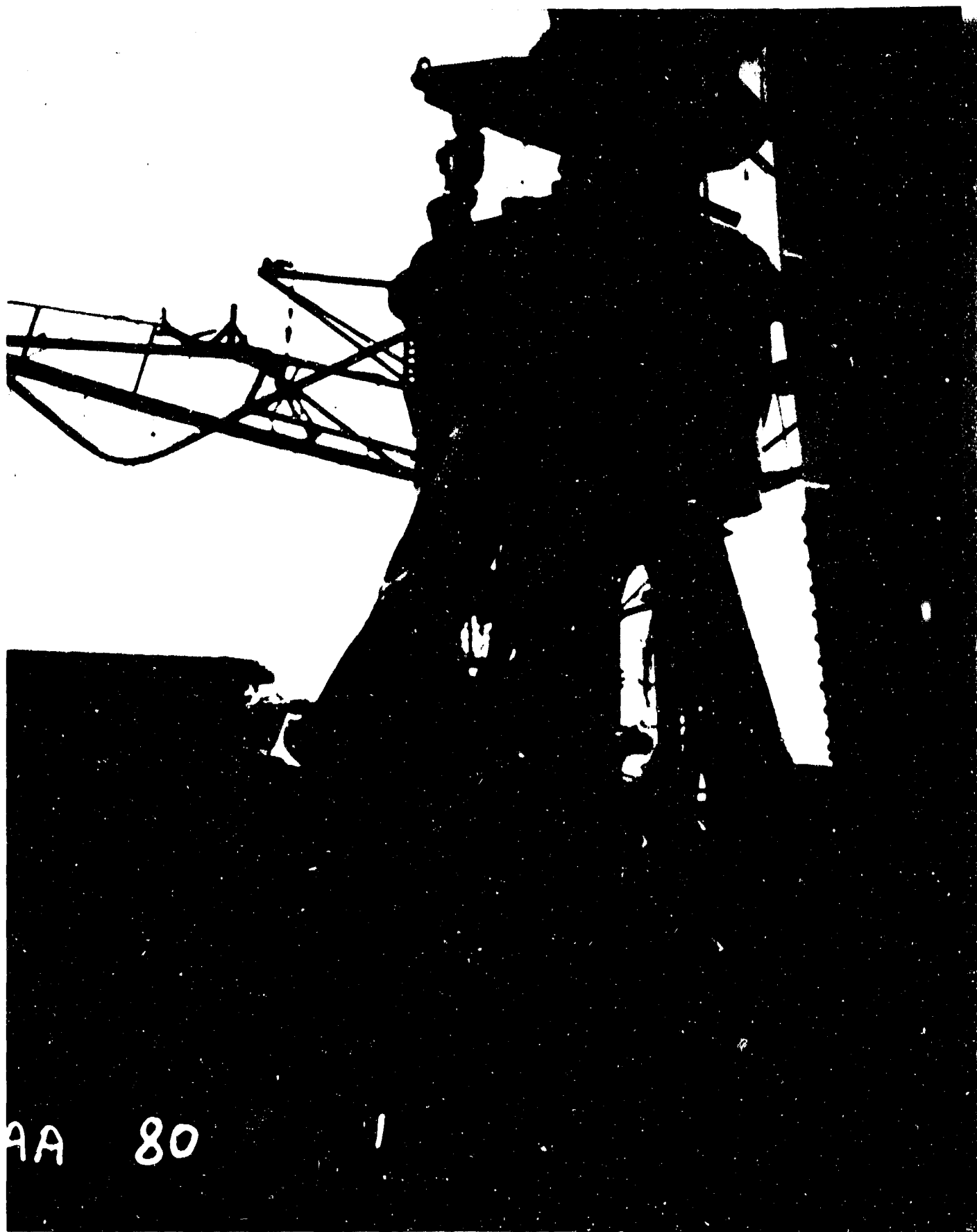
TOP SECRET



AA-CR-175-2154-8. USS NEVADA (BB36). Stanchion (16 feet off centerline) at frame 66 under 02 level, port side, showing distortion of beam and splitting of stanchion.

TOP SECRET

Page 111 of 211 Pages



AA-CR-80-1900-1. USS NEVADA (BB36). After tripod, looking aft and to port showing top of mainmast pole.

TOP SECRET

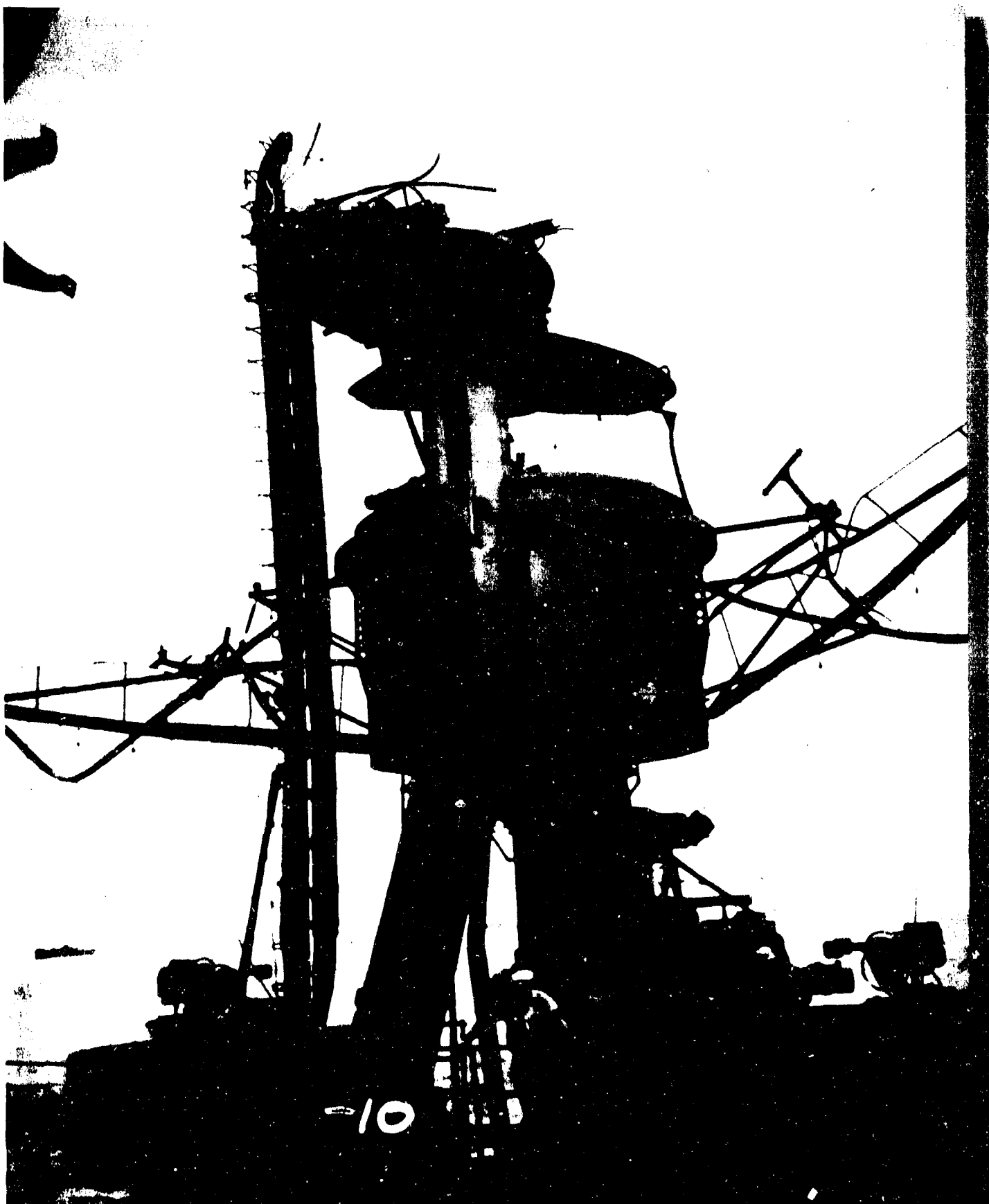
Page 112 of 211 Pages



AA-CR-80-1900-2. USS NEVADA (BB36). View looking aft from forward tripod. Lower end of mainmast pole can be seen, still in place, under top of secondary battle stations.

TOP SECRET

Page 113 of 211 Pages



AA-CR-80-1897-10. USS NEVADA (BB36). After tripod, looking aft showing mainmast and yardarms. For close-up of end of mainmast pole see 1900-7.

TOP SECRET

Page 114 of 211 Pages



AA-CR-80-1897-11. USS NEVADA (BB-3). After tripod, looking aft and to starboard.

TOP SECRET

Page 115 of 211 Pages



AA-CR-80-1900-7. USS NEVADA (BB-36). Break in mainmast pole.

TOP SECRET

Page 116 of 211 Pages



AA-CR-80-1900-8. USS NEVADA (BB36). Break in fixed part of main-mast pole.

TOP SECRET

Page 117 of 211 Pages



AA-CR-100-1889-8. USS NEVADA (BB36). Side ladder davit, frame 105, showing bend above deck edge fitting.

TOP SECRET

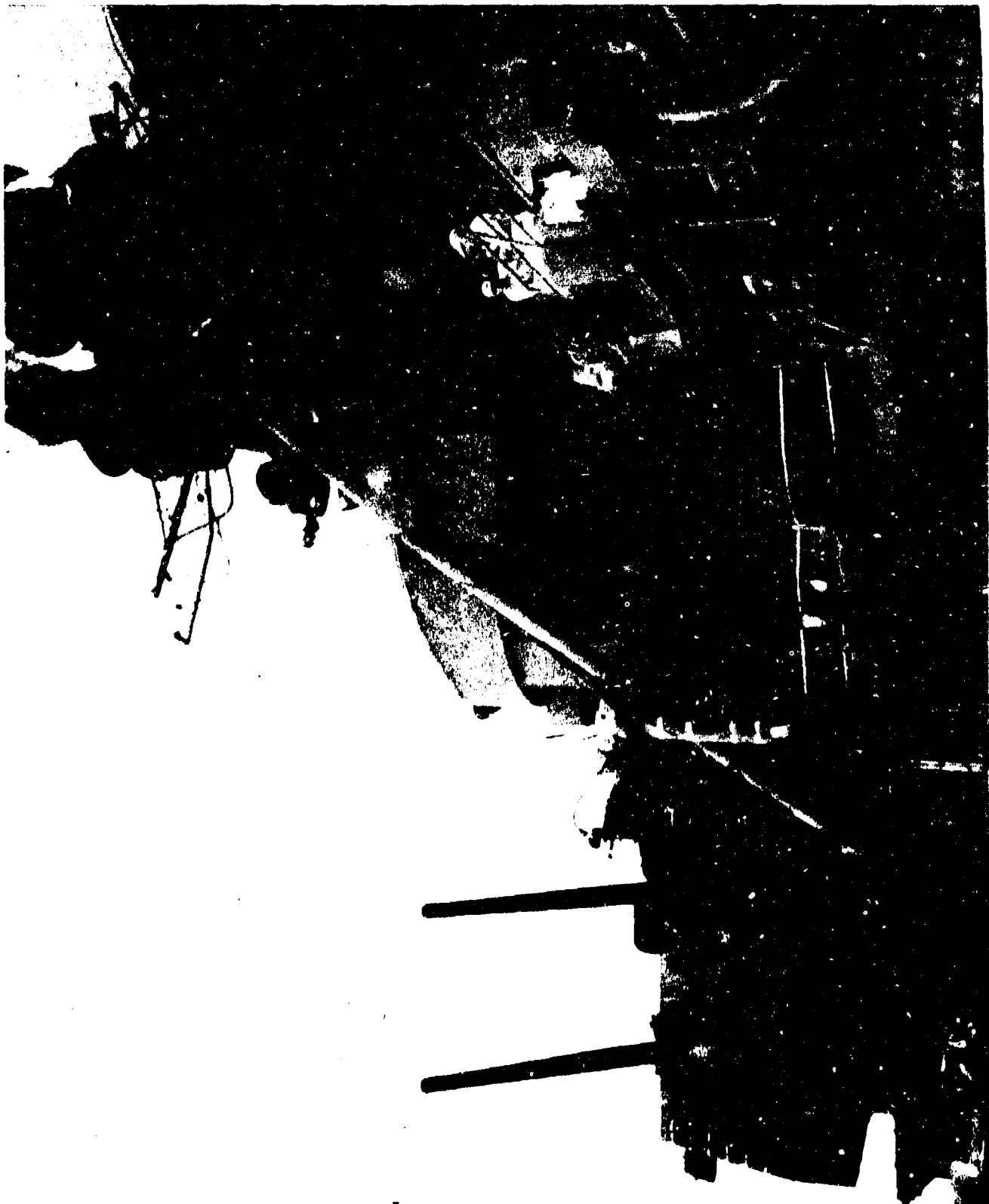
Page 118 of 211 Pages



AA-CR-100-1889-7. USS NEVADA (BB36) Port cargo boom at frame 85 1/2, showing bend in boom and location of boom after Test Able.

TOP SECRET

Page 119 of 211 Pages

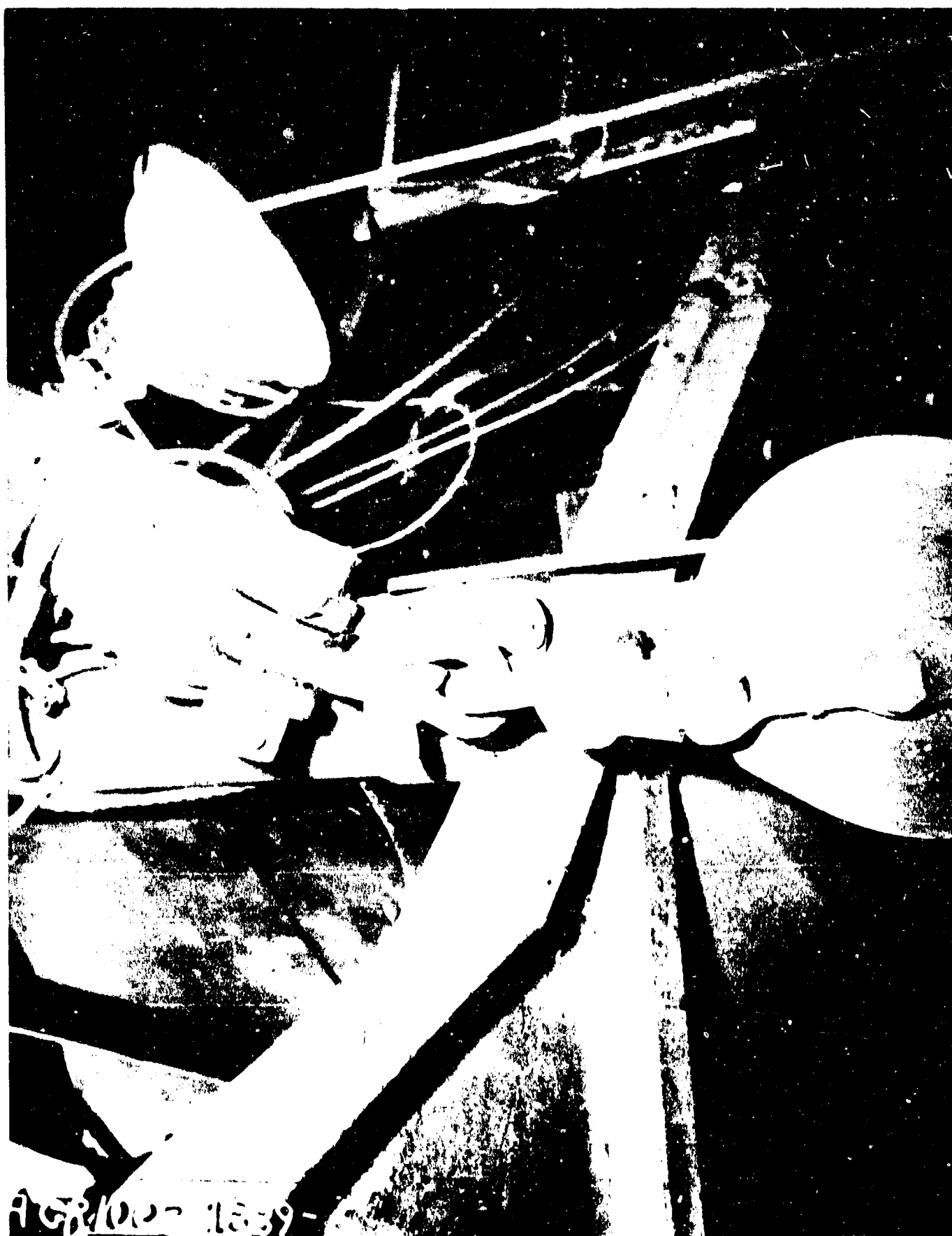


AA CR80-1900-| 5

AA-CR-80-1900-5. USS NEVADA (BB36). View, port side, looking forward at boat boom, frame 86.

TOP SECRET

Page 120 of 211 Pages



AA-CR-100-1889-5. USS NEVADA (BB36). End fitting of port cargo boom, frame 85 1/2. Looking inboard and forward. Note twist in fitting.

TOP SECRET

Page 121 of 211 Pages

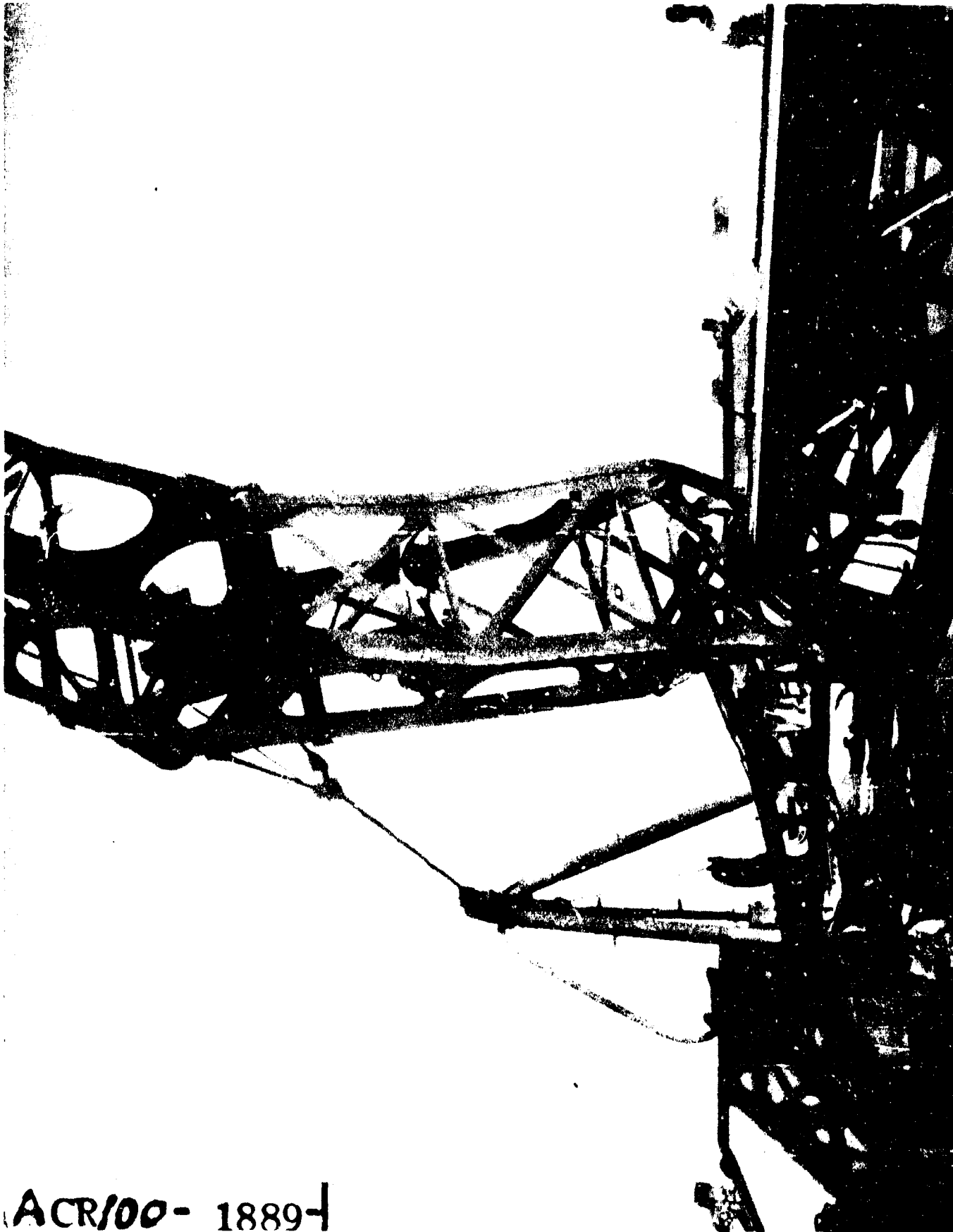


AA-CR-100-1889-9

AA-CR-100-1889-9. USS NEVADA (BB36). Stern crane, showing lower section knuckled and resting on catapult. Looking aft and to starboard.

TOP SECRET

Page 122 of 211 Pages



ACR/00- 1889-1

AA-CR-100-1889-10. USS NEVADA (BB36). Close-up of lower section of stern crane resting on catapult looking aft and to starboard.

TOP SECRET

Page 123 of 211 Pages



AA-CR-100-1889-12

AA-CR-100-1889-12. USS NEVADA (BB36). Detail of failure of lower section of crane.

TOP SECRET

Page 124 of 211 Pages



AA-CR-80-1909-4

AA-CR-80-1909-4. USS NEVADA (BB36). Looking aft at forward superstructure from starboard side.

TOP SECRET

Page 125 of 211 Pages



BA-CR-196-154-1. U.S.S. PENSACOLA (CA24). View looking at port beam. Before Test A.

TOP SECRET

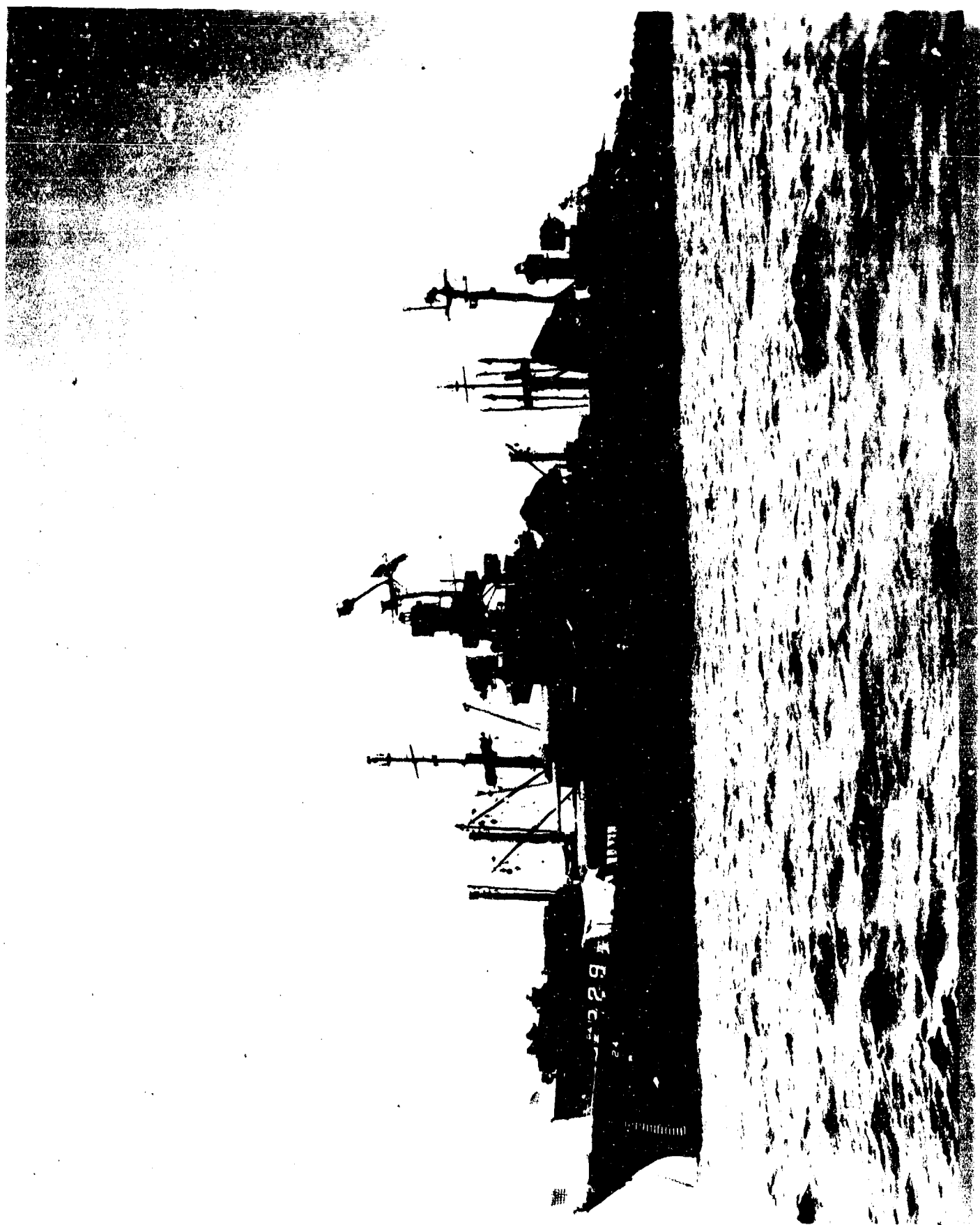
Page 126 of 211 Pages



AA-CR-227-93-45. U.S.S. PENSACOLA (CA24). View looking at starboard beam. After Test A.

TOP SECRET

Page 127 of 211 Pages



AA-CR-227-50-126. U.S.S. PENSACOLA (CA24). View looking at port bow after Test A.

TOP SECRET

Page 128 of 211 Pages



AA-CR-227-50-127. U.S.S. PENSACOLA (CA24). View looking at bow after Test A.

TOP SECRET

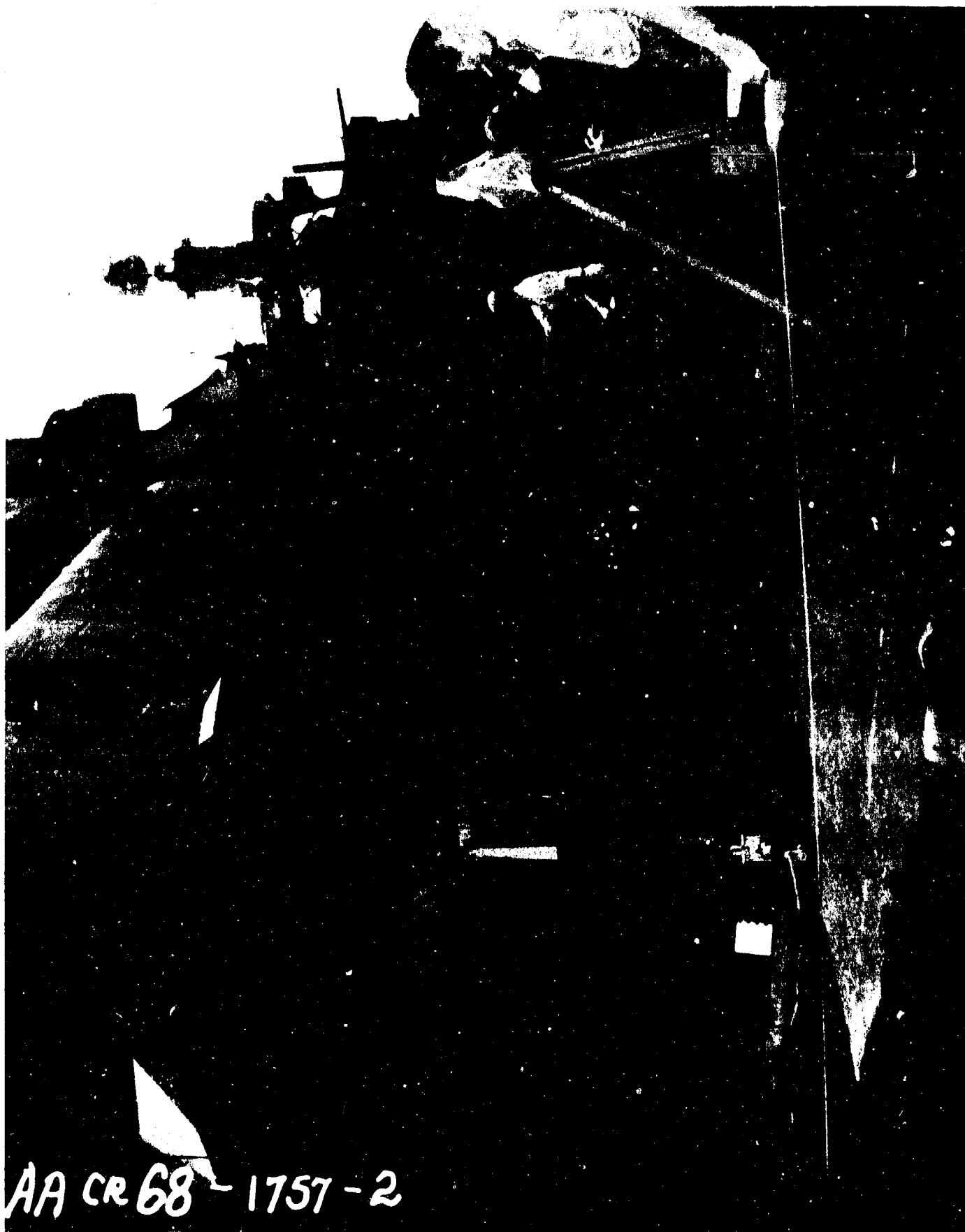
Page 129 of 211 Pages



AA-CR-68-1757-1. U.S.S. PENSACOLA (CA24). General view from main deck, port side aft, showing radar polemast and port mainmast stay.

TOP SECRET

Page 130 of 211 Pages



AA-CR-68-1757-2. U.S.S. PENSACOLA (CA24). General view taken from starboard side of main deck, aft, showing forward radar polemast and starboard mainmast stay.

TOP SECRET

Page 131 of 211 Pages

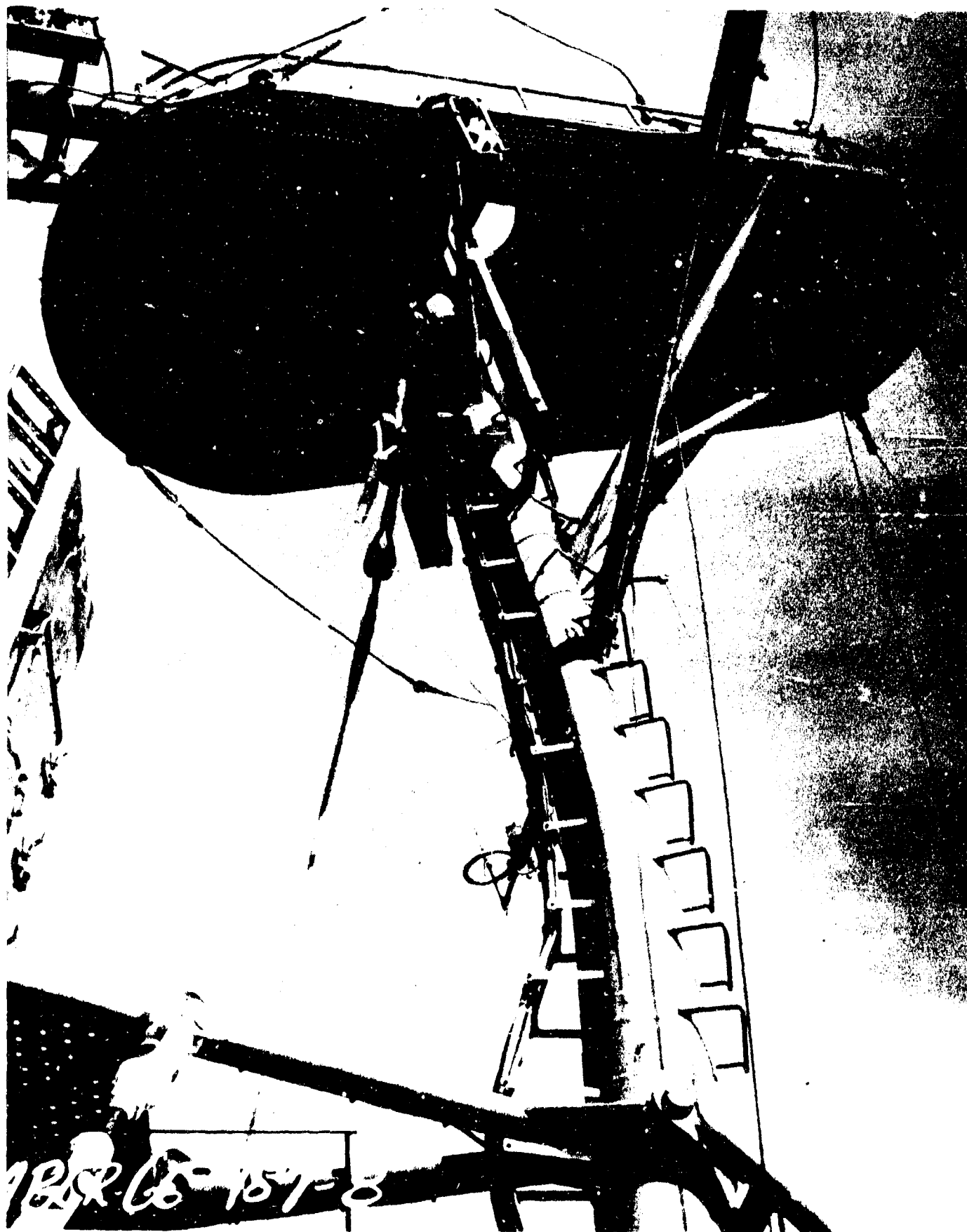


AA CR ~~68~~ - 1761A

AA-CR-68-1761-12. U.S.S. PENSACOLA (CA24). General view, looking at forward superstructure and radar polemast.

TOP SECRET

Page 132 of 211 Pages



AB-CR-66-157-8. U.S.S. PENSACOLA (CA24). Forward radar pole-mast after test Baker showing platform and riggings.

TOP SECRET

Page 133 of 211 Pages



AA-CR-68-1759-8. U.S.S. PENSACOLA (CA24). Forward radar mast and rigging, looking to starboard, after test Able. Note rigging still in place.

TOP SECRET

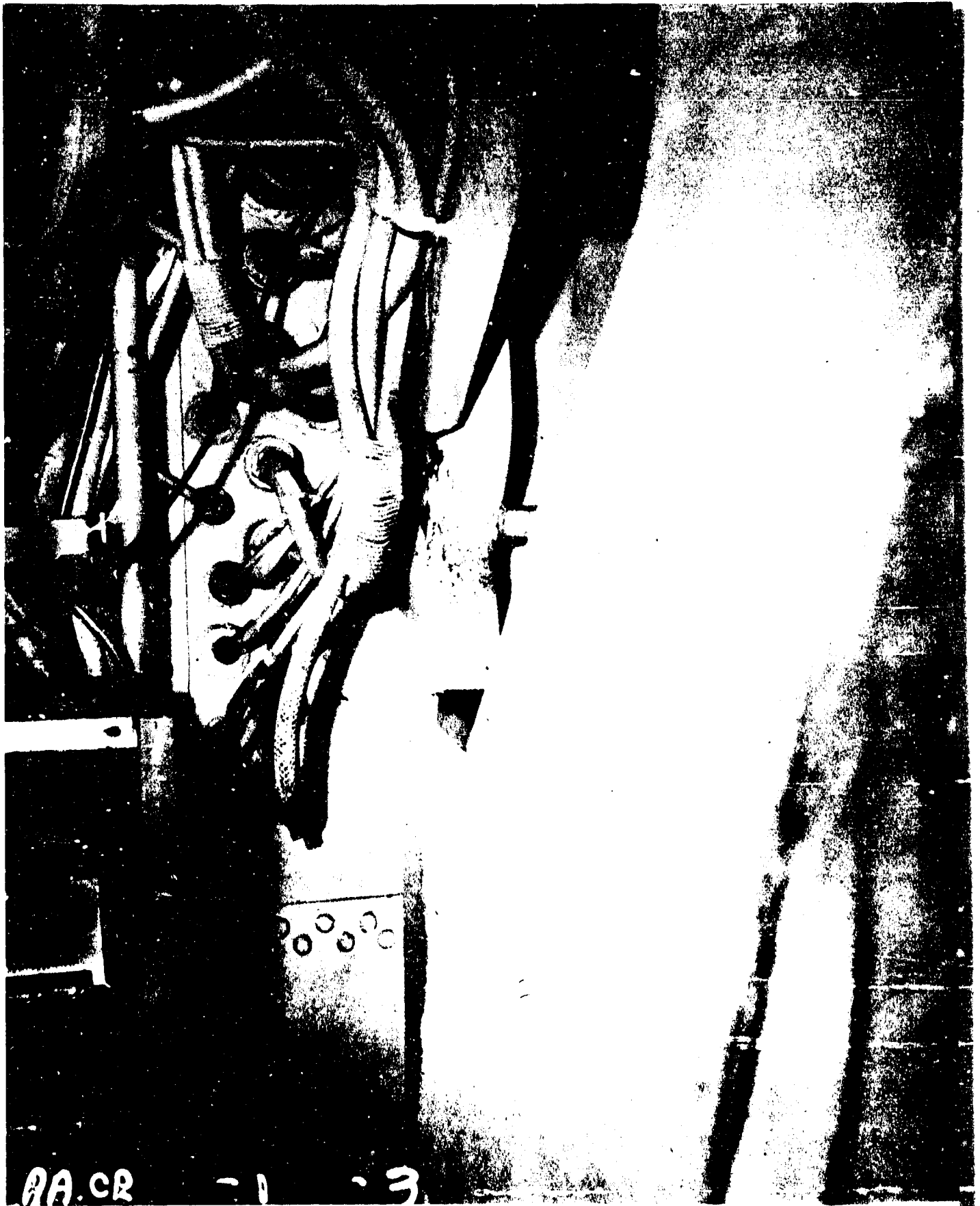
Page 134 of 211 Pages



AA-CR-68-1762-2. U.S.S. PENSACOLA (CA24). bulkhead No. 42, showing crushing at centerline under forward leg of forward tripod. Looking aft from starboard side.

TOP SECRET

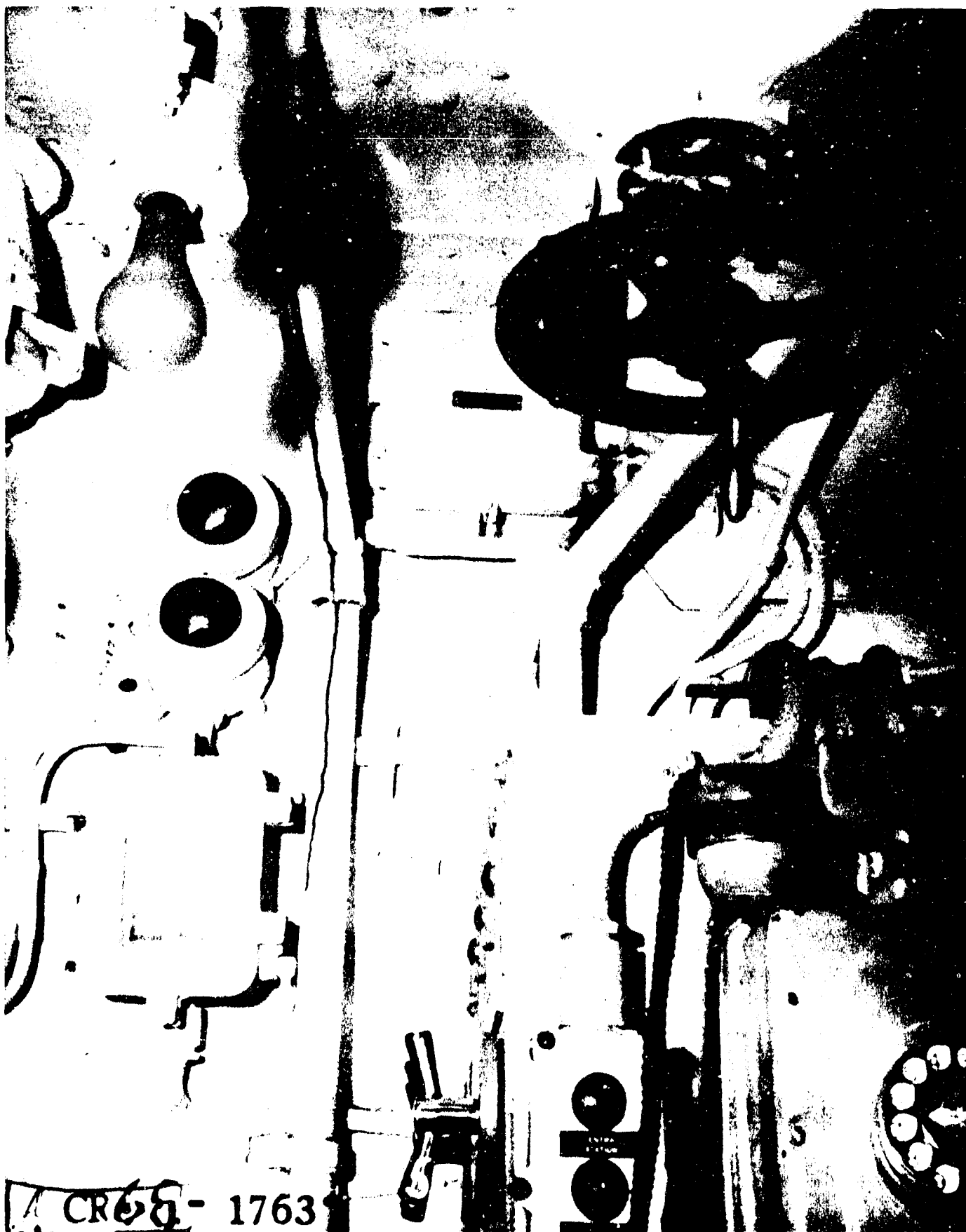
Page 135 of 211 Pages



AA-CR-68-1762-3. U.S.S. PENSACOLA (CA24). Bulkhead No. 42, lower end of starboard bracket about 18 inches off centerline. Looking aft, between first and second platforms.

TOP SECRET

Page 136 of 211 Pages



AA-CR-68-1763-5. U.S.S. PENSACOLA (CA24). Bulkhead No. 42, looking forward at centerline of slips between first and second platforms.

TOP SECRET

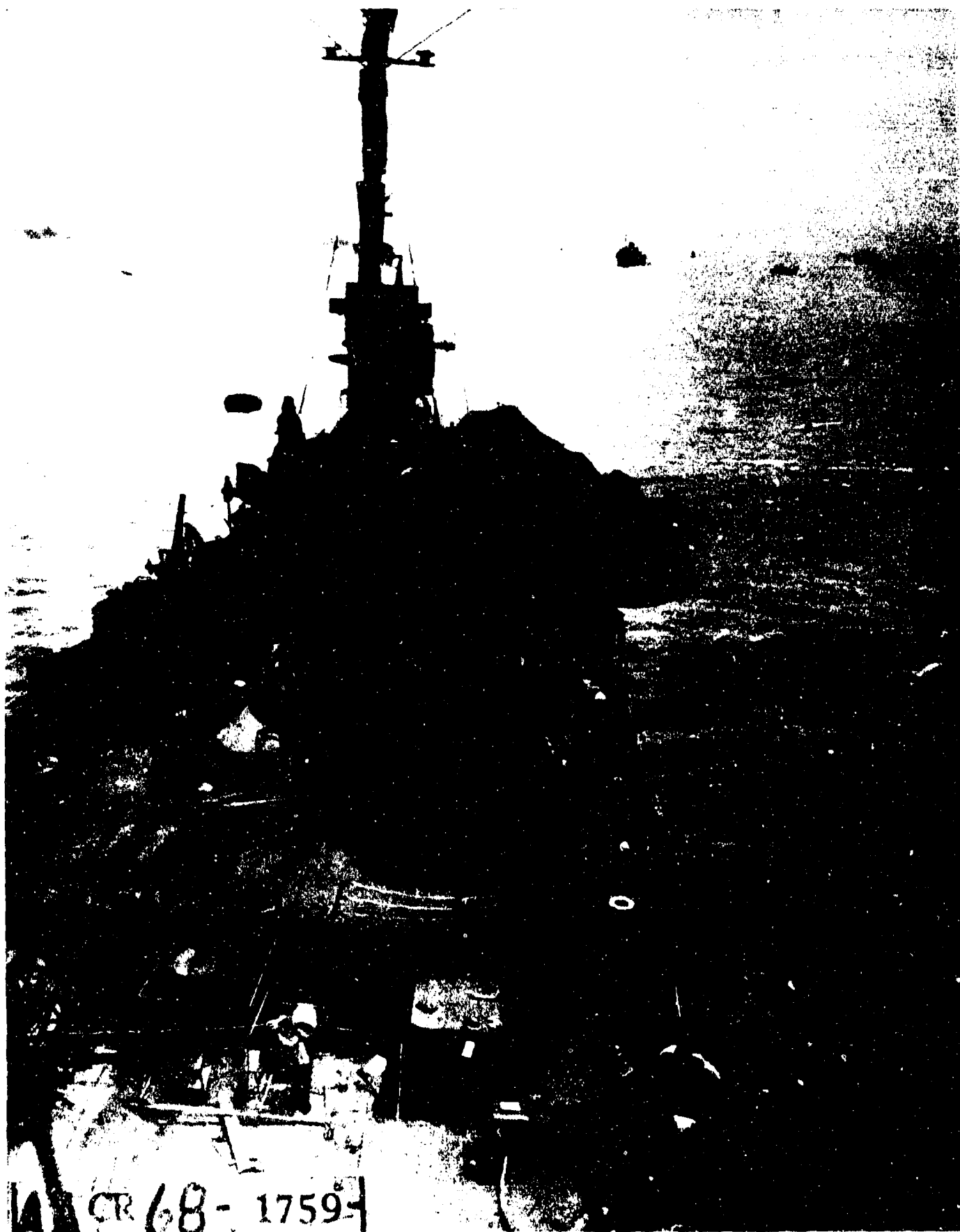
Page 137 of 211 Pages



AA-CR-68-1763-6. U.S.S. PENSACOLA (CA24). Bulkhead No. 42, looking forward at centerline of ship between first and second platform.

TOP SECRET

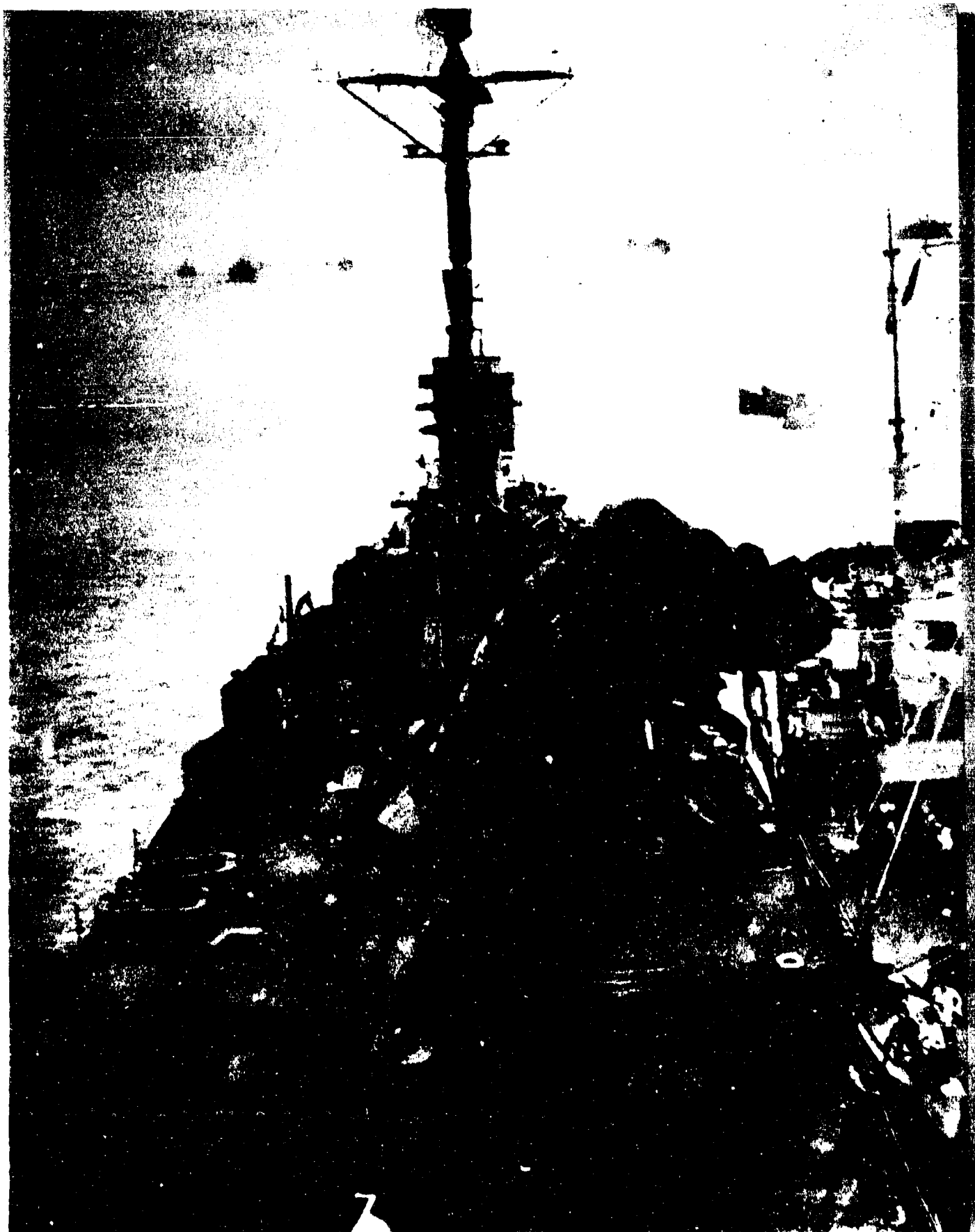
Page 138 of 211 Pages



AA-CR-68-1759-4. U.S.S. PENSACOLA (CA24). Looking aft at mainmast showing yardarm and stays.

TOP SECRET

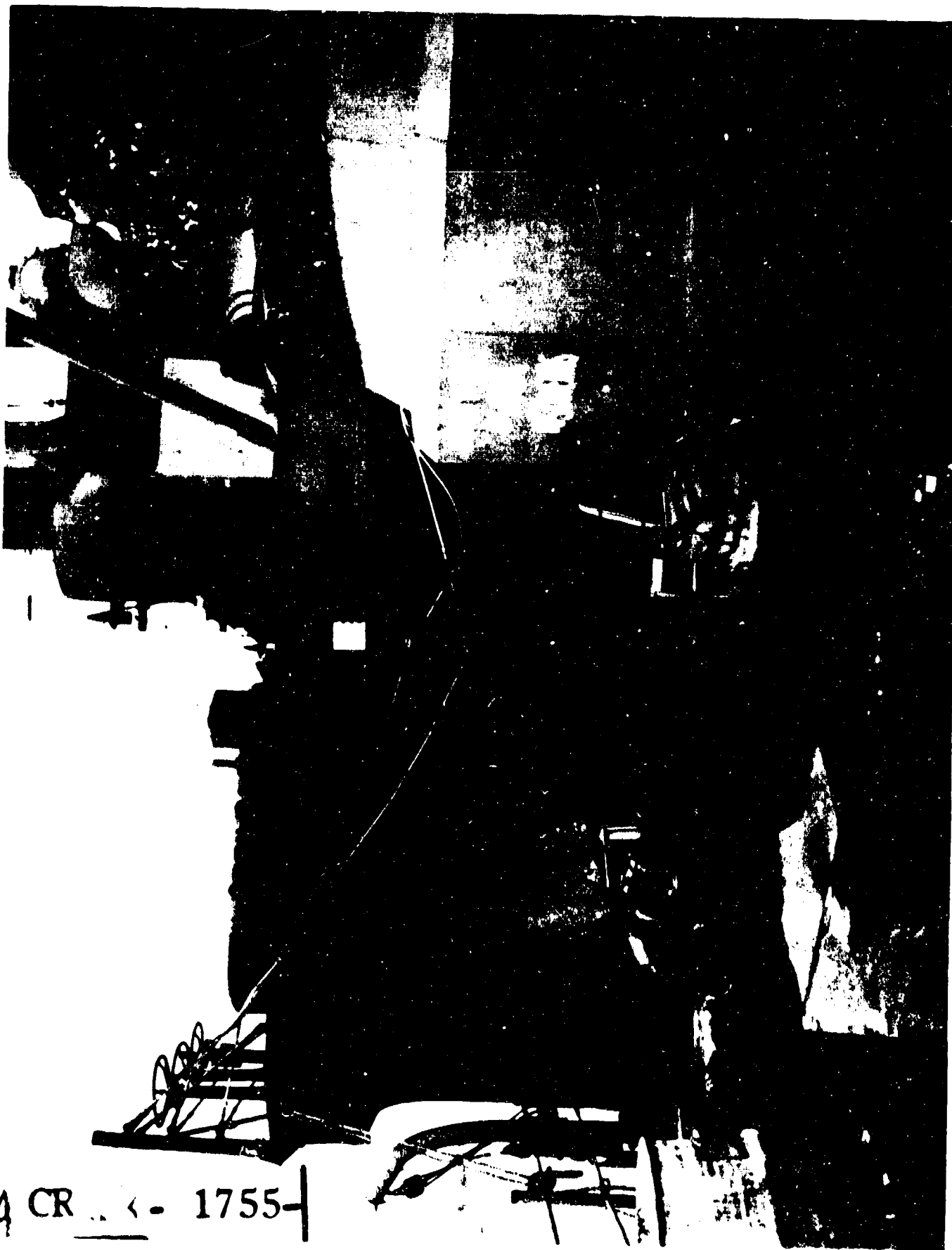
Page 139 of 211 Pages



AA-CR-98-1968-7. U.S.S. PENSACOLA (CA24). General view looking aft.

. TOP SECRET

Page 140 of 211 Pages

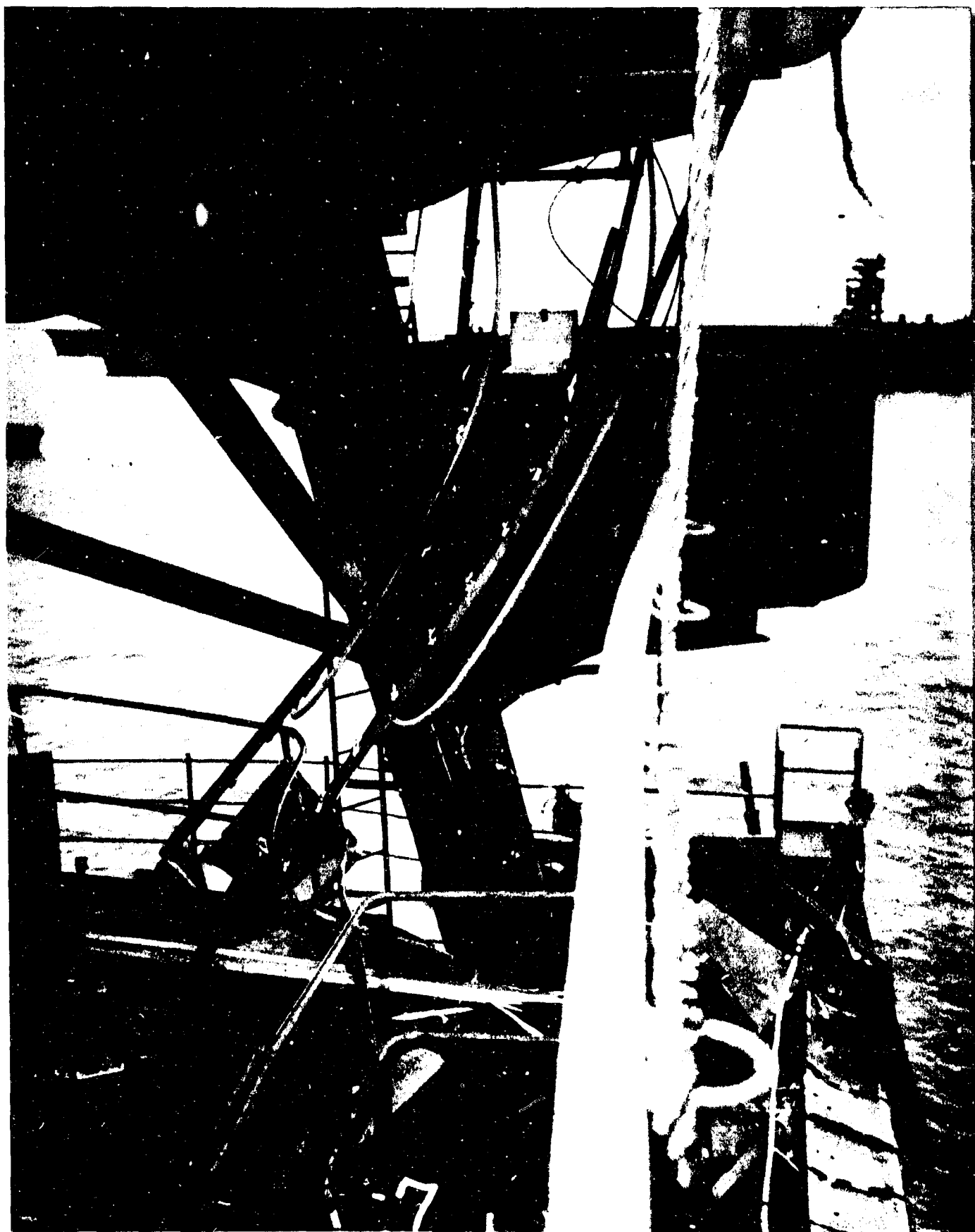


4 CR - 1755-

AA-CR-68-1755-10. U.S.S. PENSACOLA (CA24). Main mast strut and stay. Note life lines.

TOP SECRET

Page 141 of 211 Pages



AA-CR-68-1759-7. U.S.S. PENSACOLA (CA24). View looking to starboard from tub in port leg. Note handrail.

TOP SECRET

Page 142 of 211 Pages



AA-CR-68-1755-9. U.S.S. PENSACOLA (CA24). View looking aft at mainmast and airplane boom tripod.

TOP SECRET

Page 143 of 211 Pages



AA-CR-68-1757-11. U.S.S. PENSACOLA (CA24). Mainmast, strut and stays.



AA-CR-68-1761-3. U.S.S. PENSACOLA (CA24). Mainmast, looking forward and up at junction of struts.

TOP SECRET

Page 145 of 211 Pages



AA-CR-88-2161-5. U.S.S. PENSACOLA (CA24). Foot of port strut to mainmast after test able.

TOP SECRET

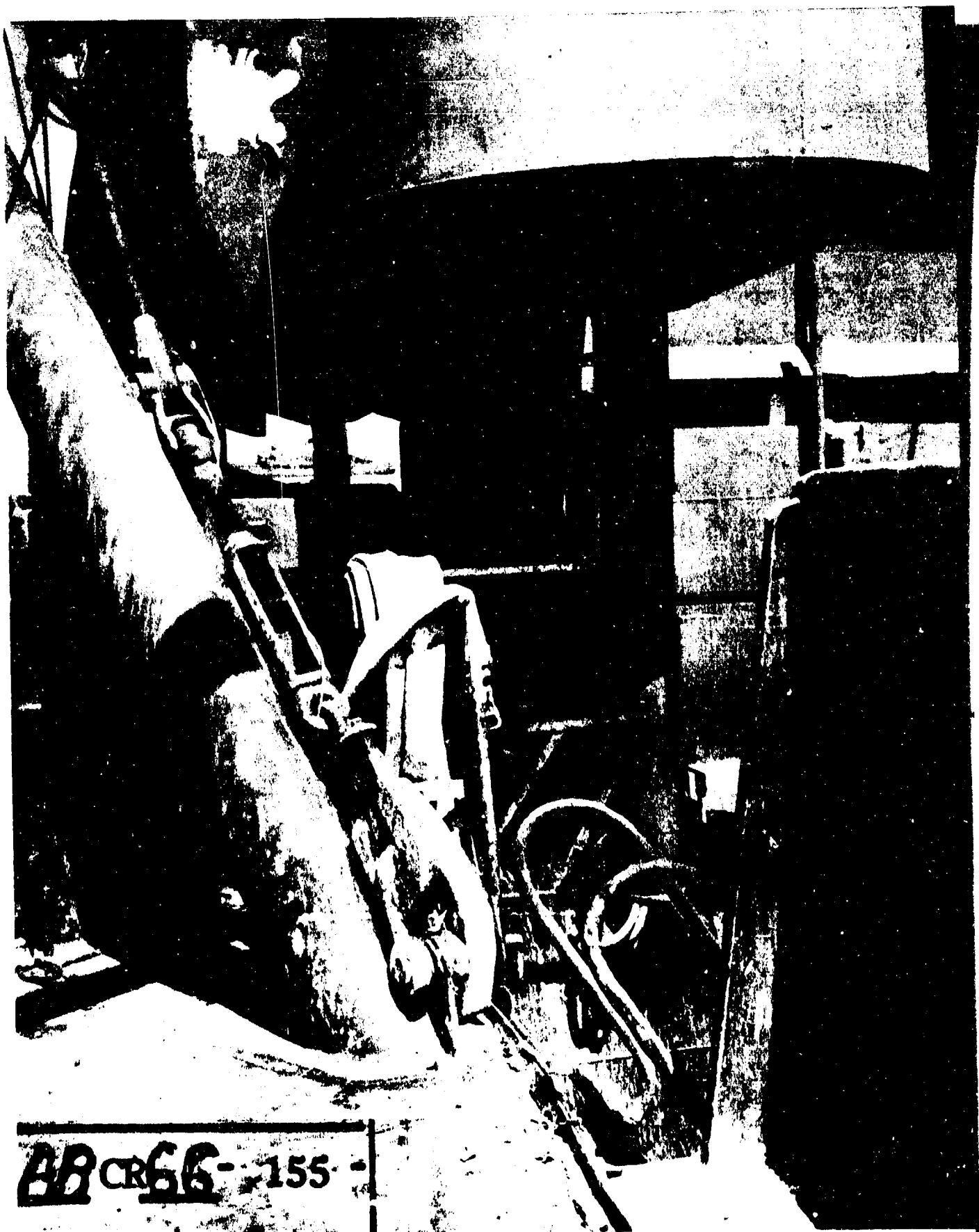
Page 146 of 211 Pages



AA-CR-88-2161-6. U.S.S. PENSACOLA (CA24). Foot of starboard strut to mainmast after Test Able.

TOP SECRET

Page 147 of 211 Pages



AB-CR-66-155-5. U.S.S. PENSACOLA (CA24). Foot of port strut to mainmast after Test Able.

TOP SECRET

Page 148 of 211 Pages



AA CR 88-2161 -

AA-CR-88-2161-7. U.S.S. PENSACOLA (CA24). Underside of super-structure deck in way of starboard strut to mainmast. After test Able.

TOP SECRET

Page 149 of 211 Pages



AA-CR-68-1757-6. U.S.S. PENSACOLA (CA24). Looking up at under side of 01 deck showing base of port after leg of mainmast strut - frame 92.

TOP SECRET

Page 150 of 211 Pages



AA-CR-68-1757-7. U.S.S. PENSACOLA (CA24). Looking up at underside of 01 deck showing base of starboard after leg of mainmast strut-frame 92.

TOP SECRET

Page 151 of 211 Pages

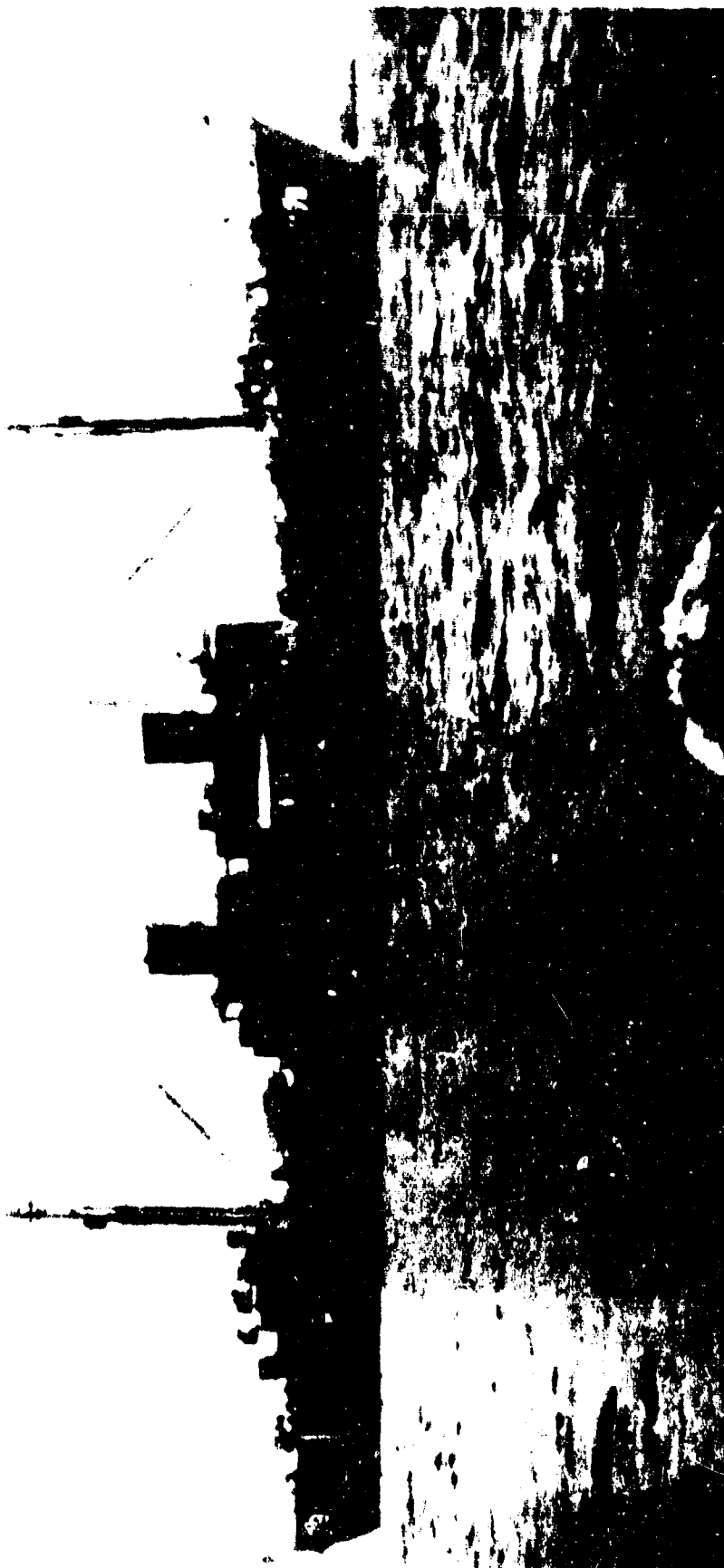


AA-CR-88-2161-9. U.S.S. PENSACOLA (CA24). 5# bulkhead and door panel under mainmast buckled.

TOP SECRET

Page 152 of 211 Pages

BA-CR-196-156-37 DAWSON 12 JUNE 46



BA-CR-196-156-37. U.S.S. DAWSON (APA79). View looking at starboard beam before Test A.

TOP SECRET

Page 153 of 211 Pages



BA-CR-196-156-39. U.S.S. DAWSON (APA79). View looking at stern, before Test A.

TOP SECRET

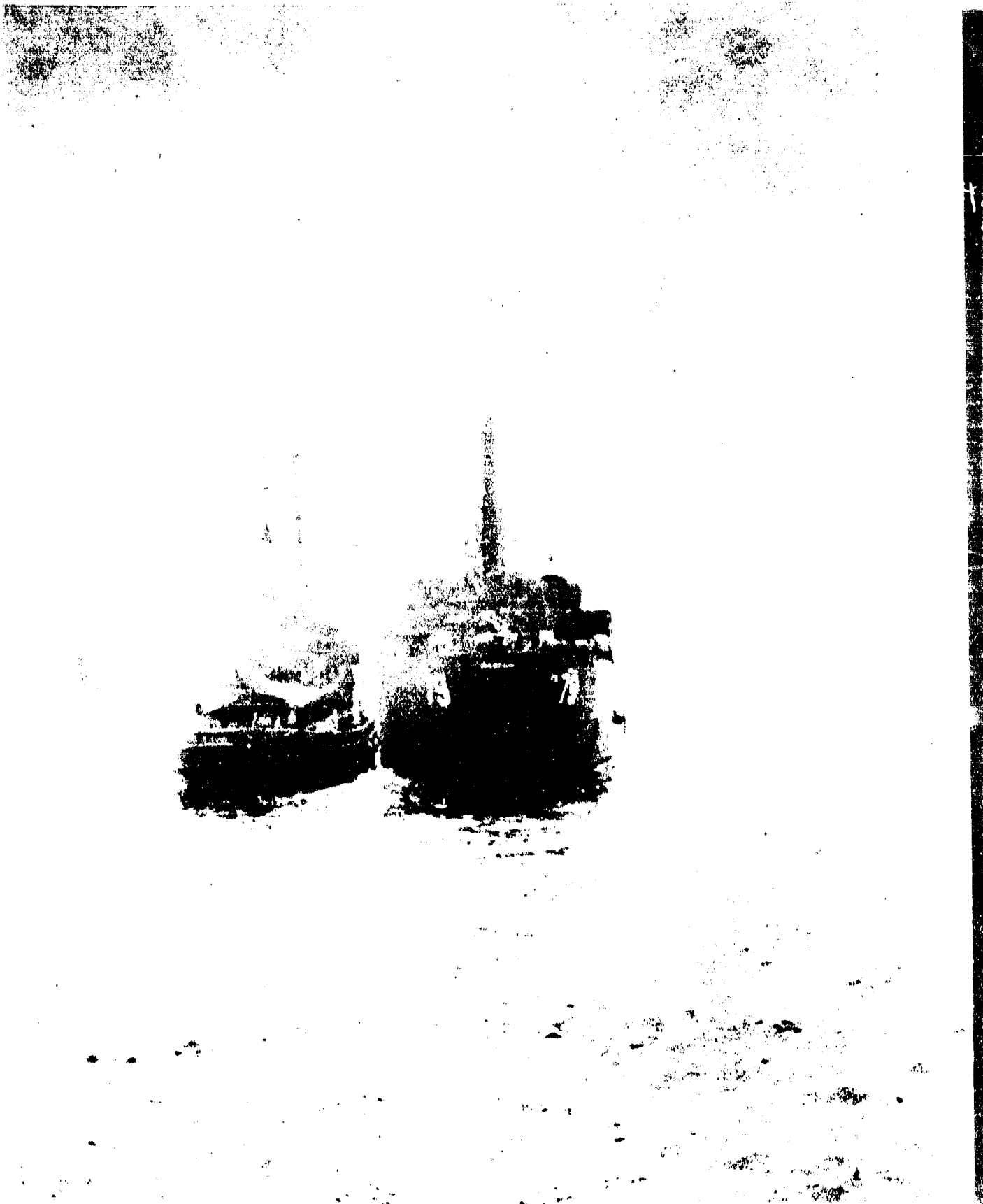
Page 154 of 211 Pages



AA-CR-227-87-64. U.S.S. DAWSON (APA 79). View looking at starboard beam after Test A.

TOP SECRET

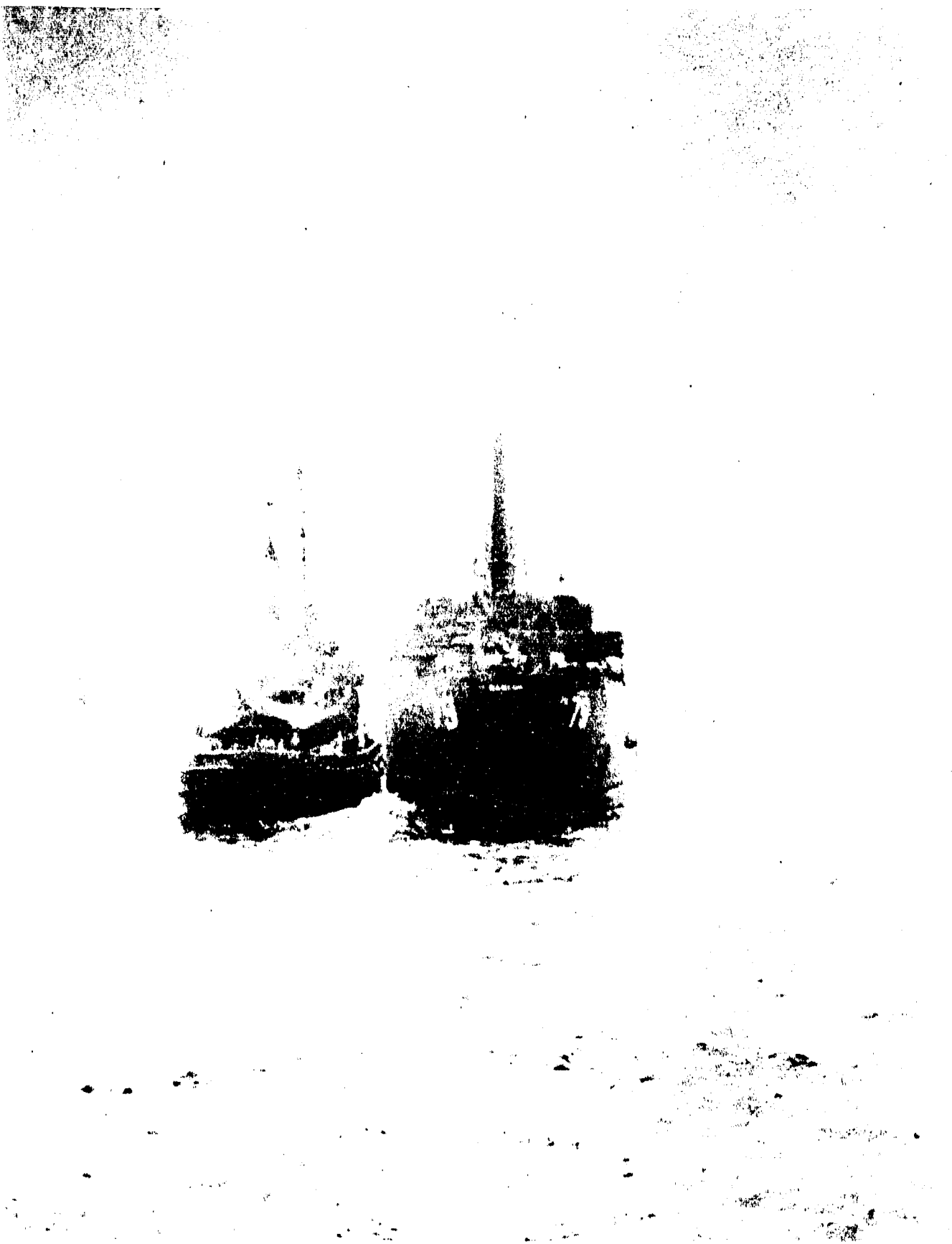
Page 155 of 211 Pages



AA-CR-227-87-66. U.S.S. DAWSON (APA79). View looking at stern after Test A.

TOP SECRET

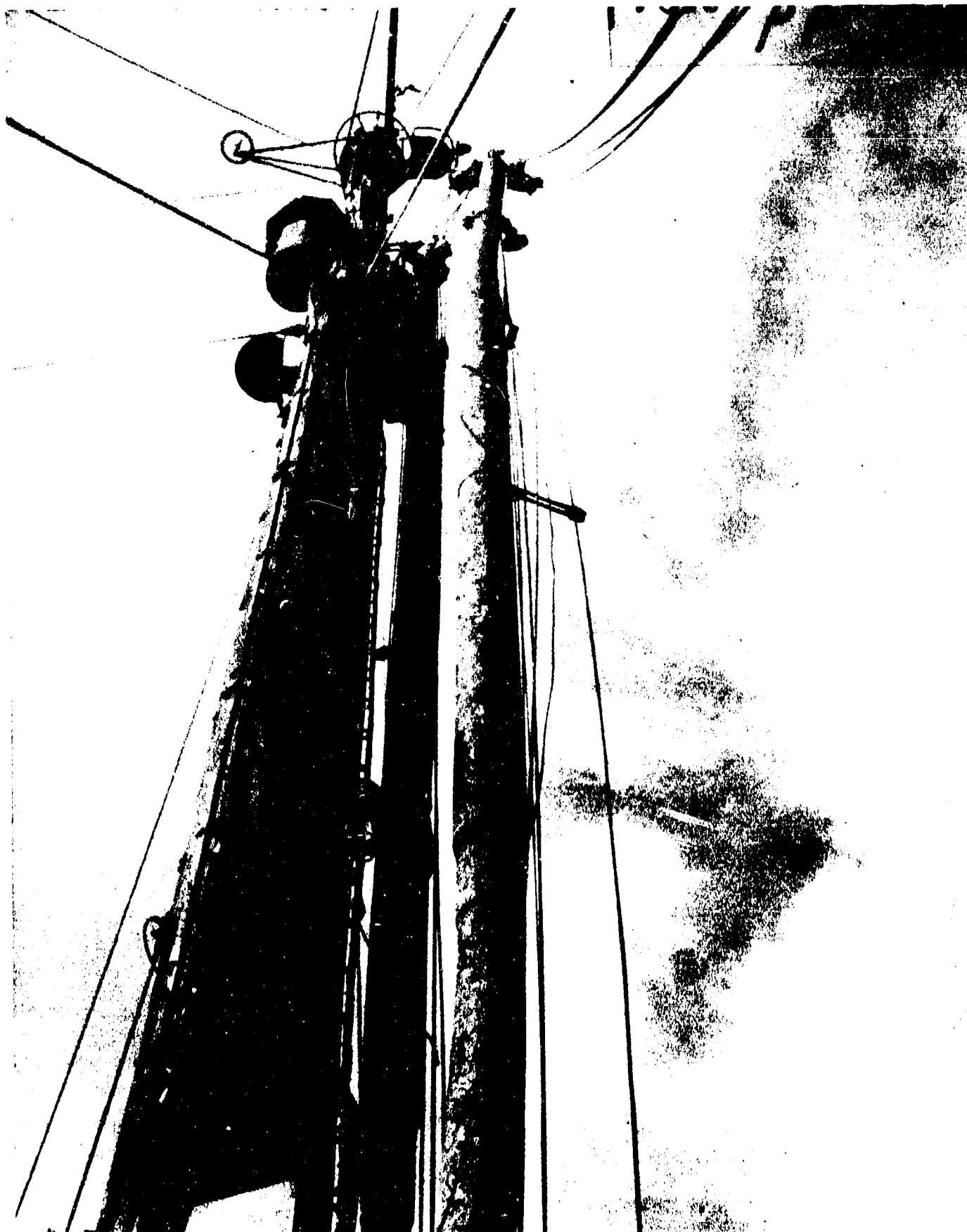
Page 156 of 211 Pages



AA-CR-227-87-66. U.S.S. DAWSON (APA79). View looking at stern after Test A.

TOP SECRET

Page 156 of 211 Pages

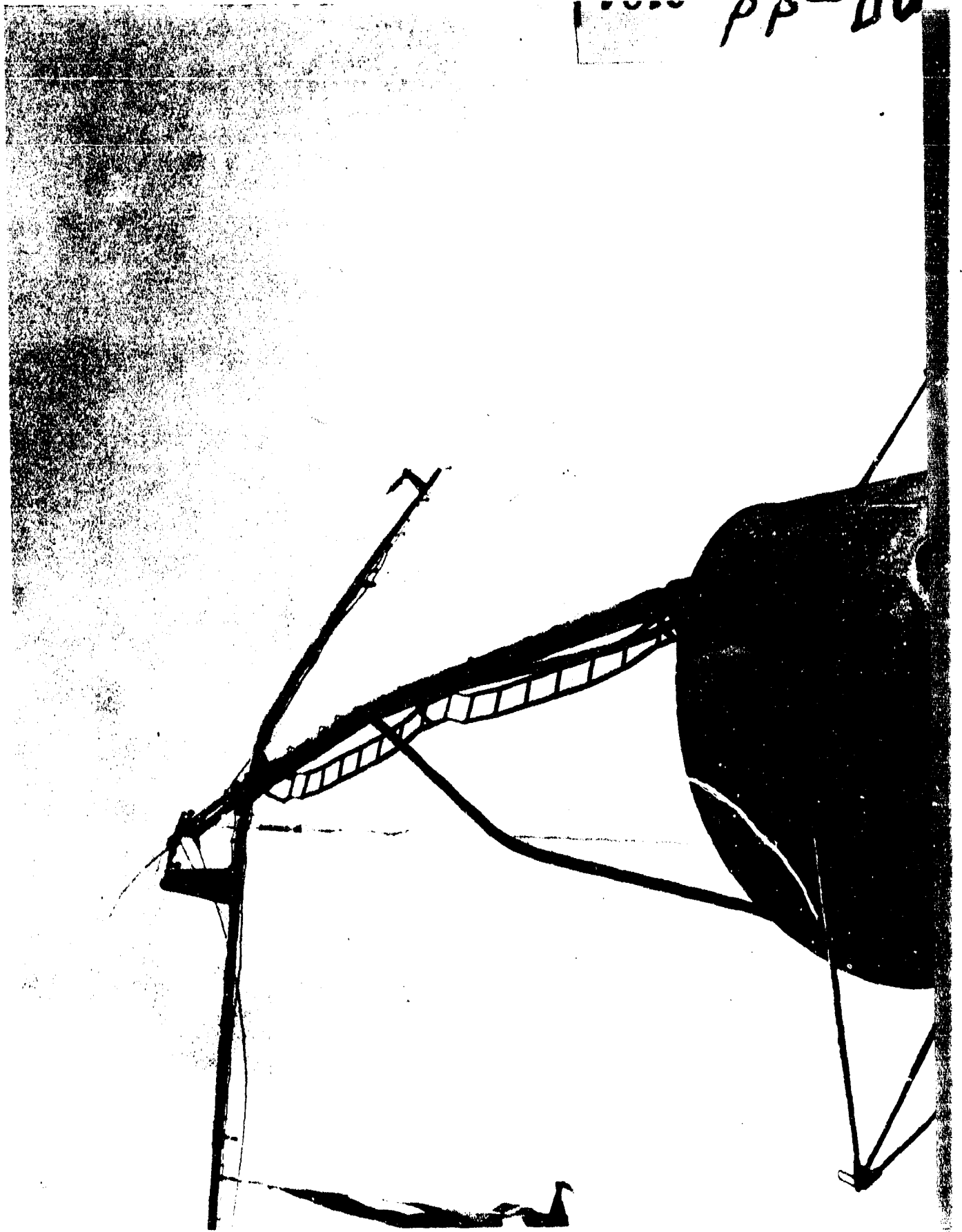


AA-CR-88-2104-6. U.S.S. DAWSON (APA79). Bends in port forward stack.

TOP SECRET

Page 157 of 211 Pages

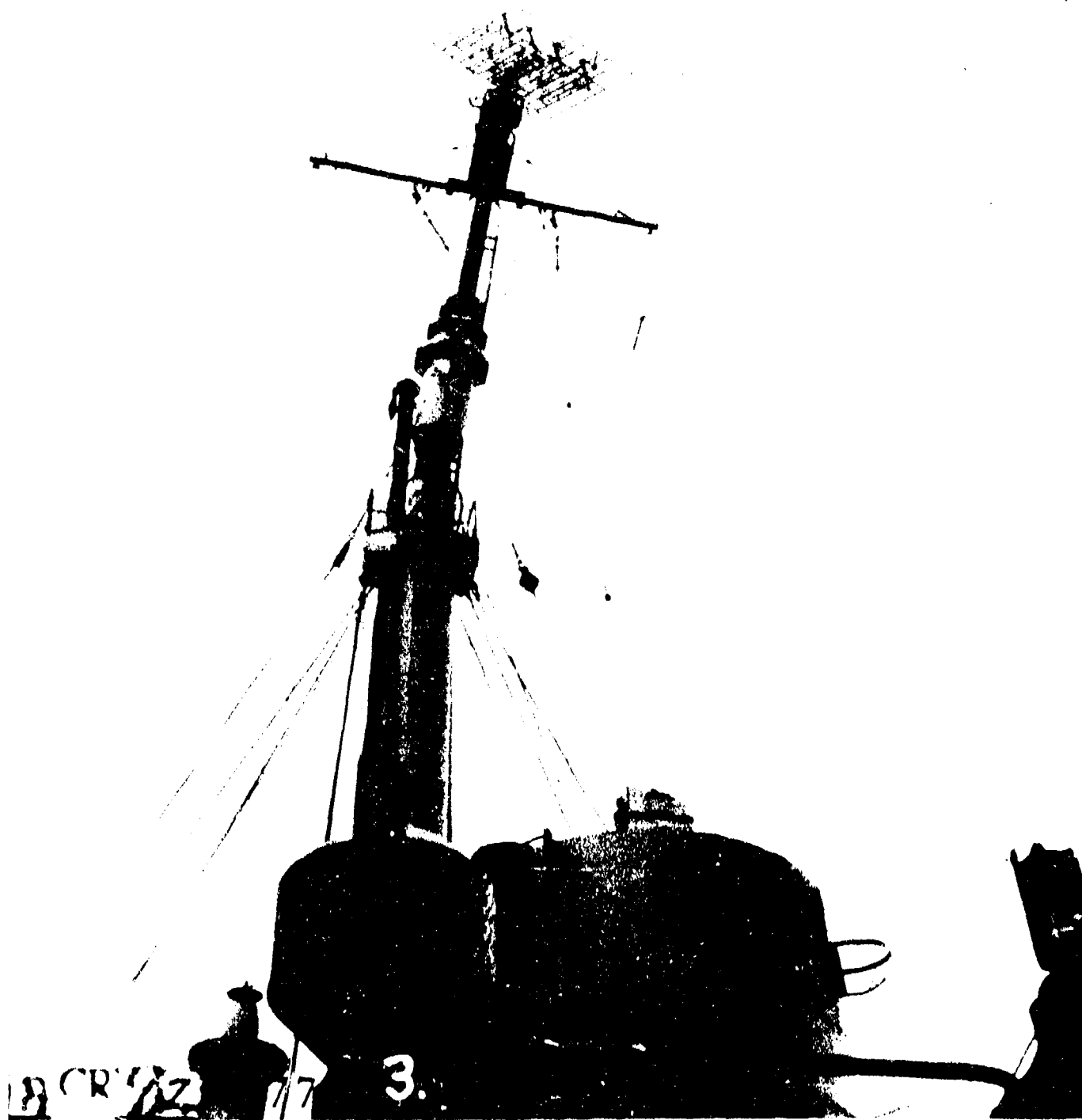
PP-00



AA-CR-88-2104-10. U.S.S. DAWSON (APA79). Signal mast on forward stack.

TOP SECRET

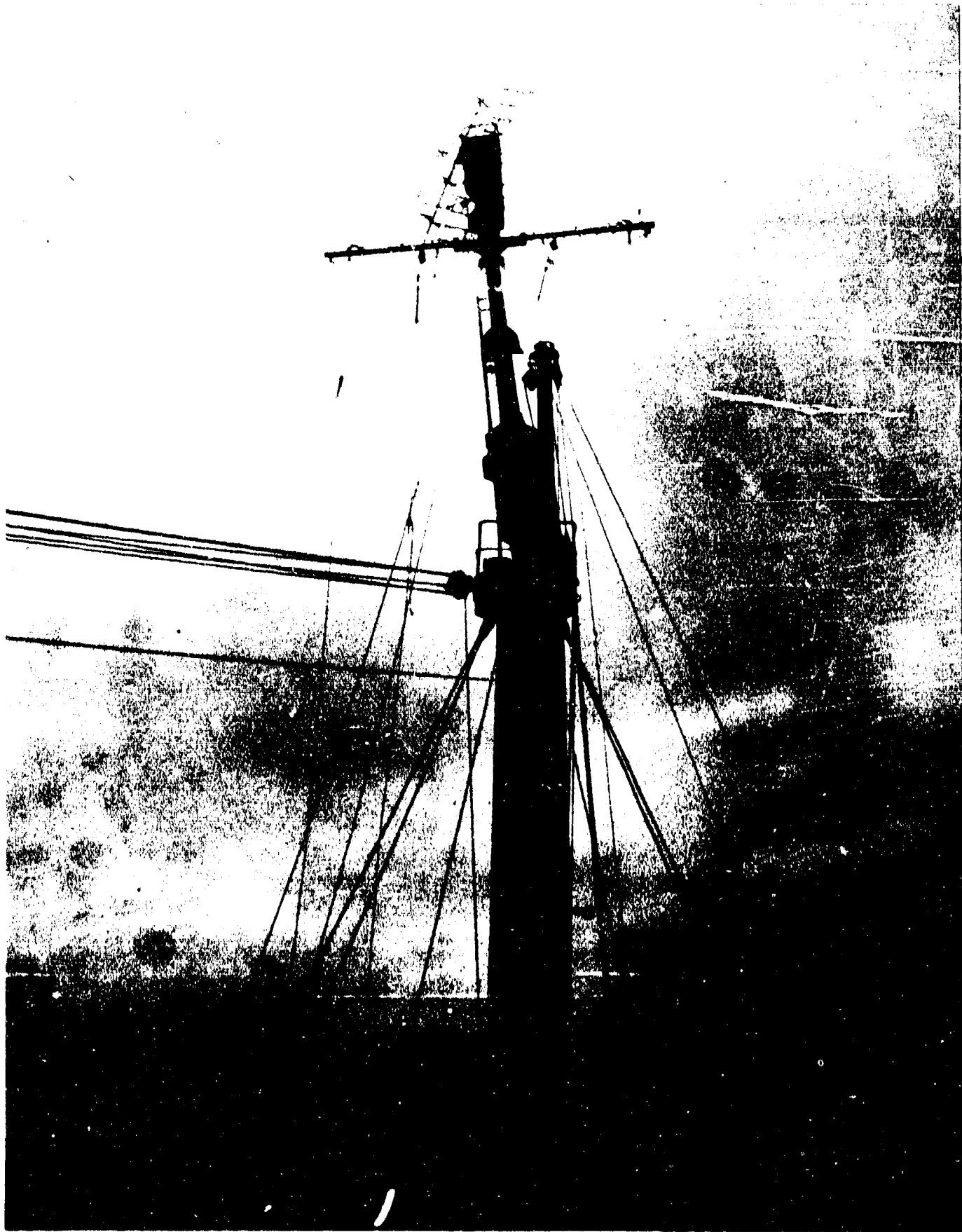
Page 158 of 211 Pages



AA-CR-92-1773-3. U.S.S. DAWSON (APA79). Main topmast, looking forward showing rigging still in place.

TOP SECRET

Page 159 of 211 Pages



AA-CR-88-2103-1. U.S.S. DAWSON (APA79). Bend in main topmast showing displacement to starboard. Looking aft.

TOP SECRET

Page 160 of 211 Pages



AA-CR-82-1922-9. U.S.S. DAWSON (APA79). View of No. 4 davit.

TOP SECRET

Page 161 of 211 Pages

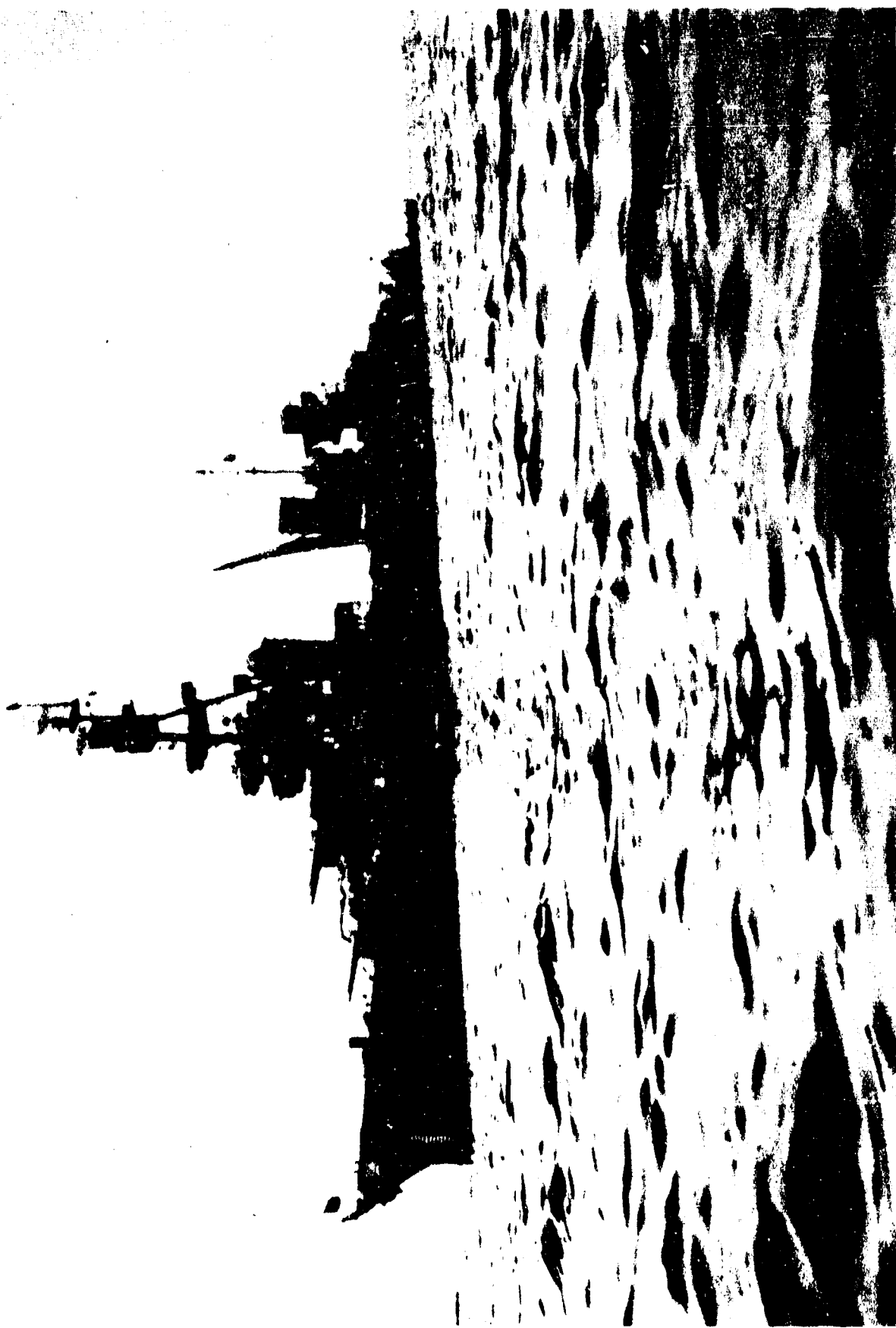


BA-CR-196-159-11. U.S.S. SALT LAKE CITY (CA25). View looking at port beam before Test A.

TOP SECRET

Page 162 of 211 Pages

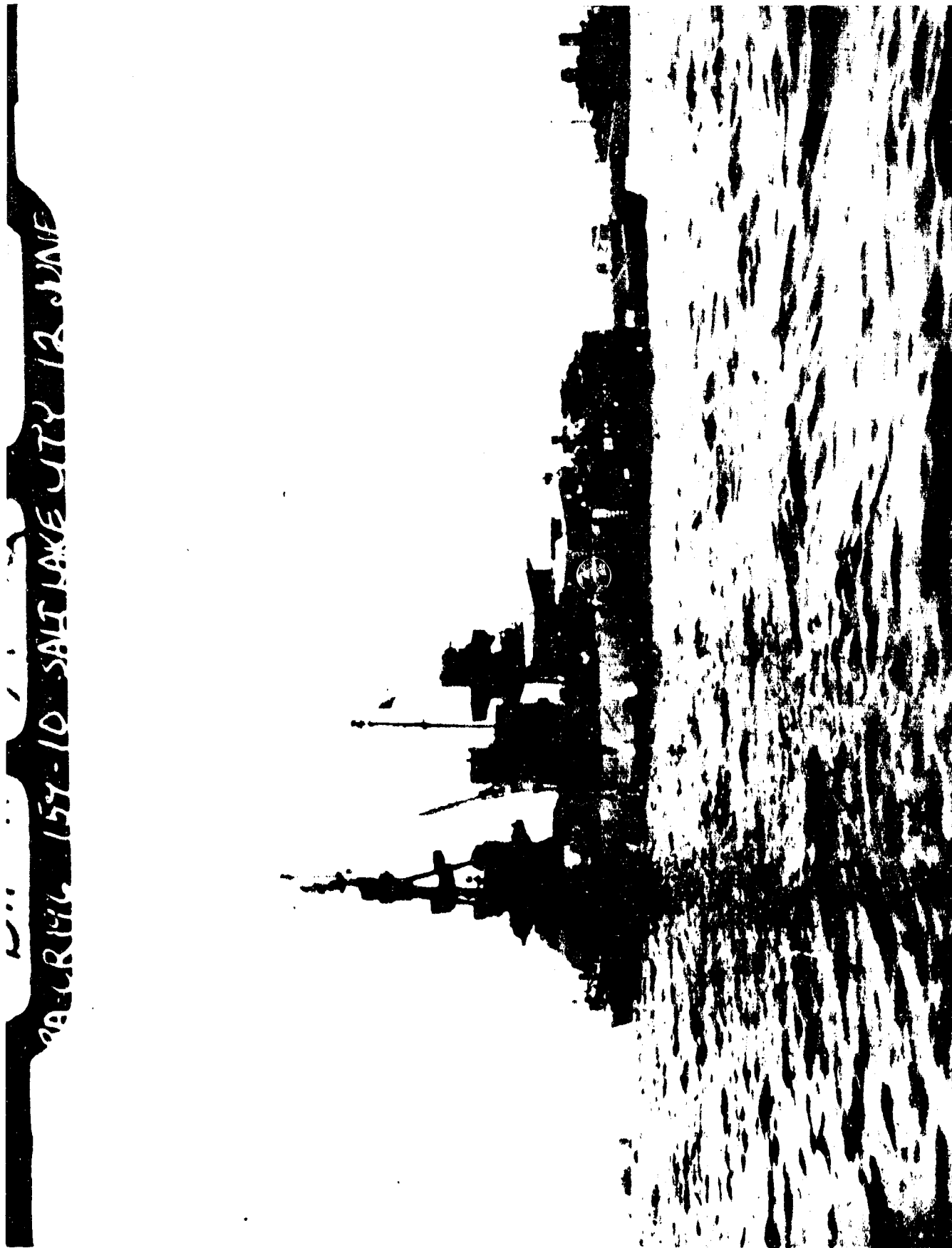
90-28146 154-12 SALT LAKE CITY 12 JUN



BA-CR-196-159-12. U.S.S. SALT LAKE CITY (CA25). View looking at port bow before Test A.

TOP SECRET

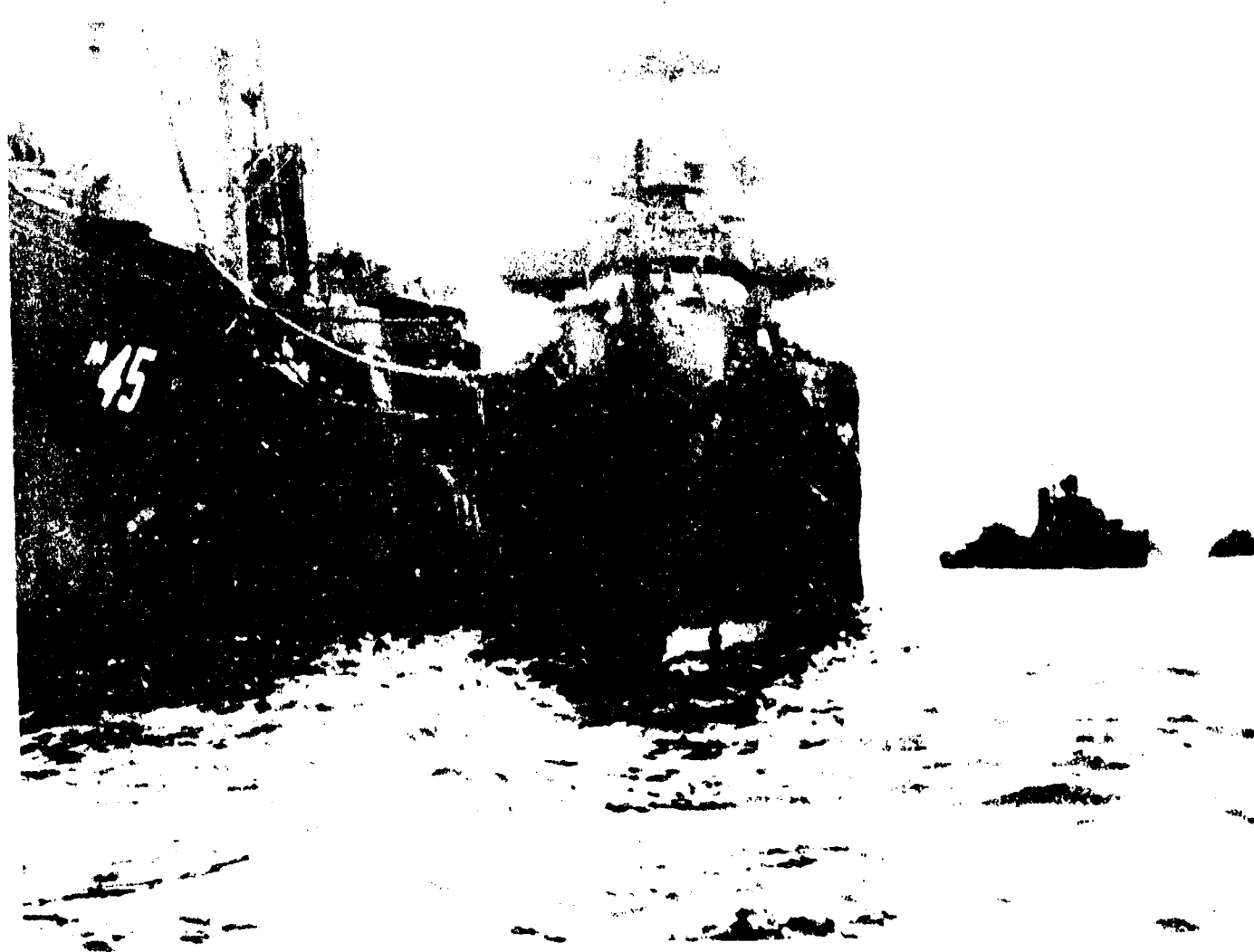
Page 163 of 211 Pages



BA-CR-196-159-10. U.S.S. SALT LAKE CITY (CA25). View looking at port quarter before Test A.

TOP SECRET

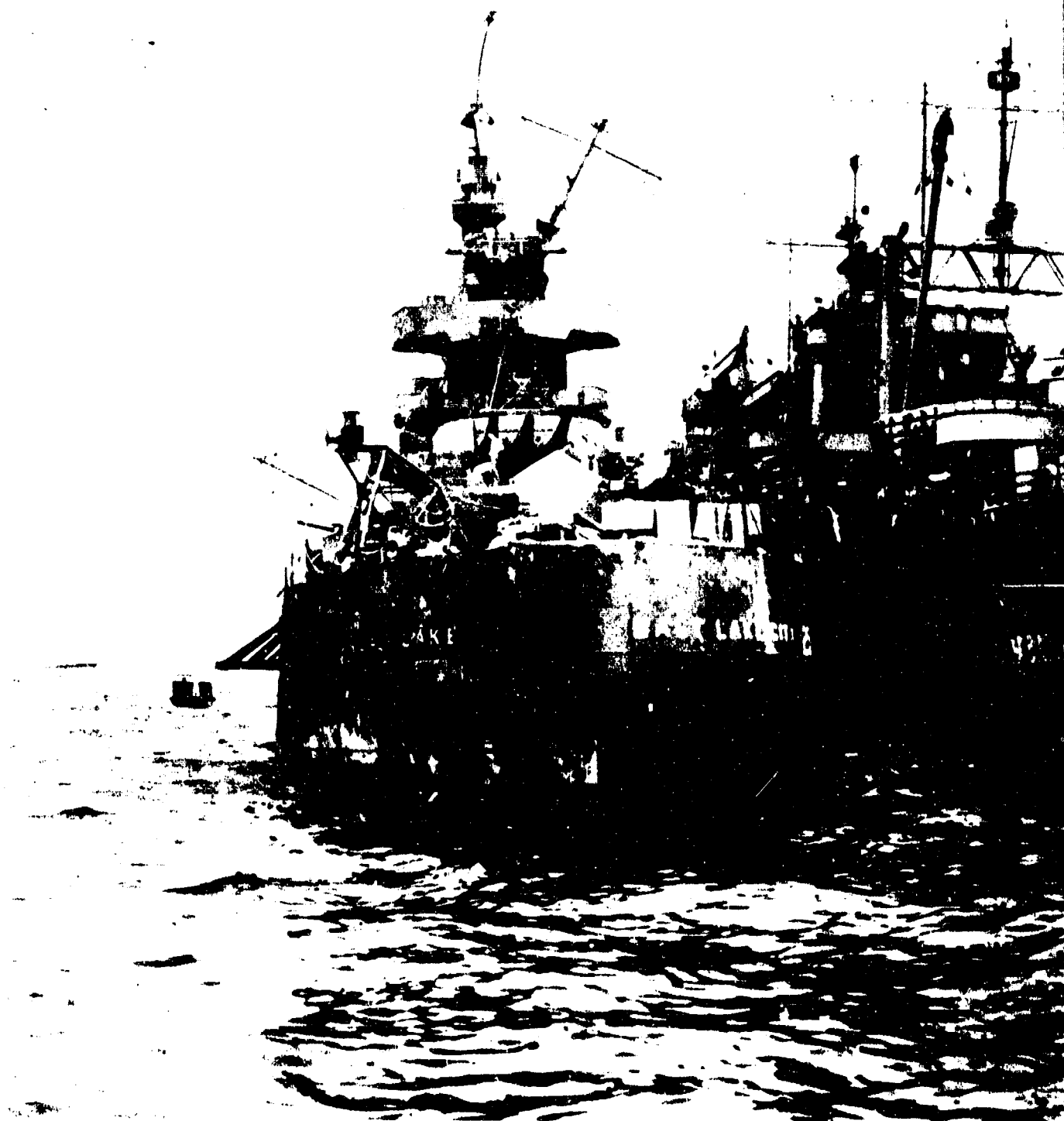
Page 164 of 211 Pages



AA-CR-227-50-117. U.S.S. SALT LAKE CITY (CA25). View looking at bow after Test A.

TOP SECRET

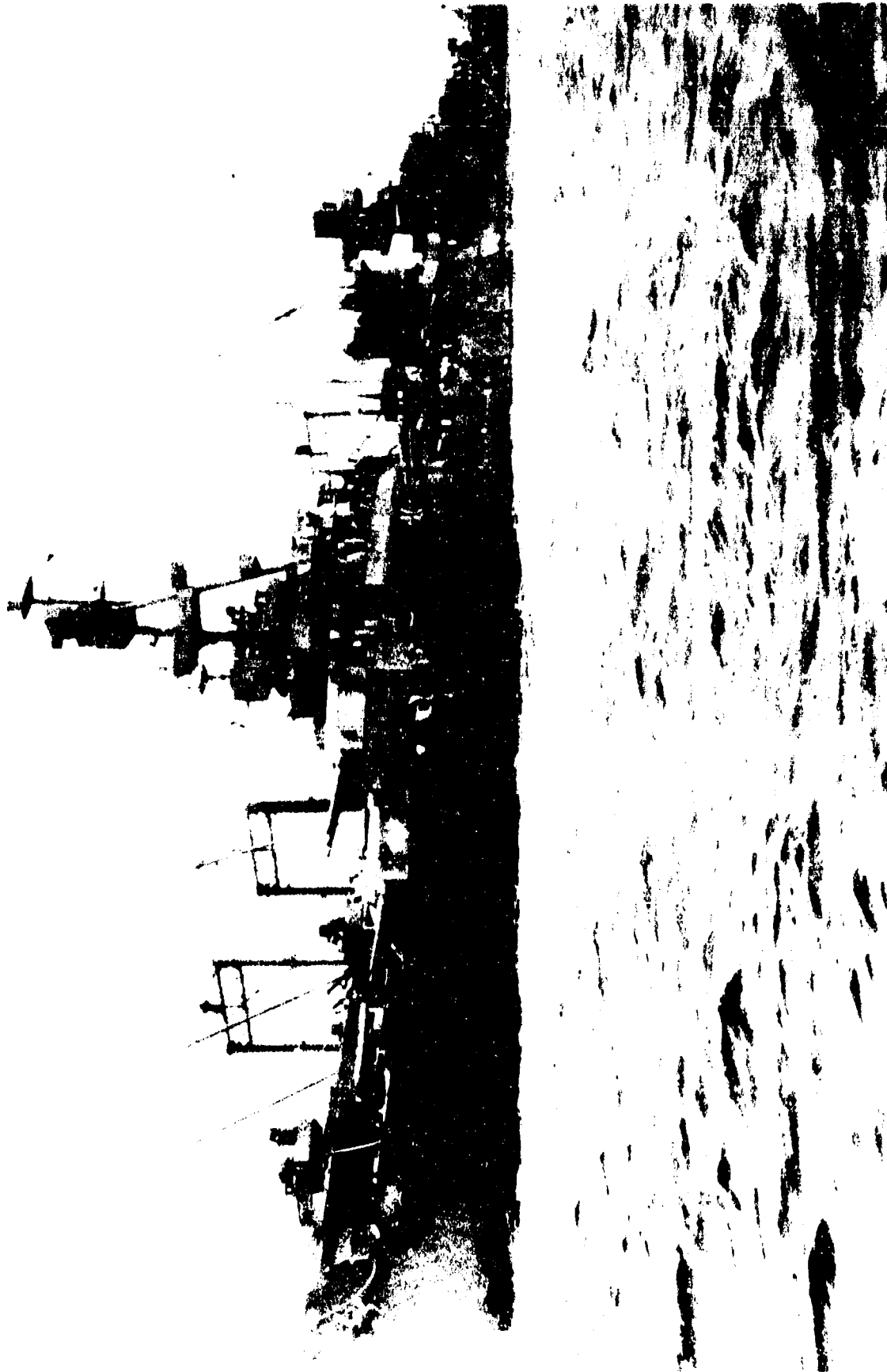
Page 165 of 211 Pages



AA-CR-227-50-113. U.S.S. SALT LAKE CITY (CA25). View looking at stern after Test A.

TOP SECRET

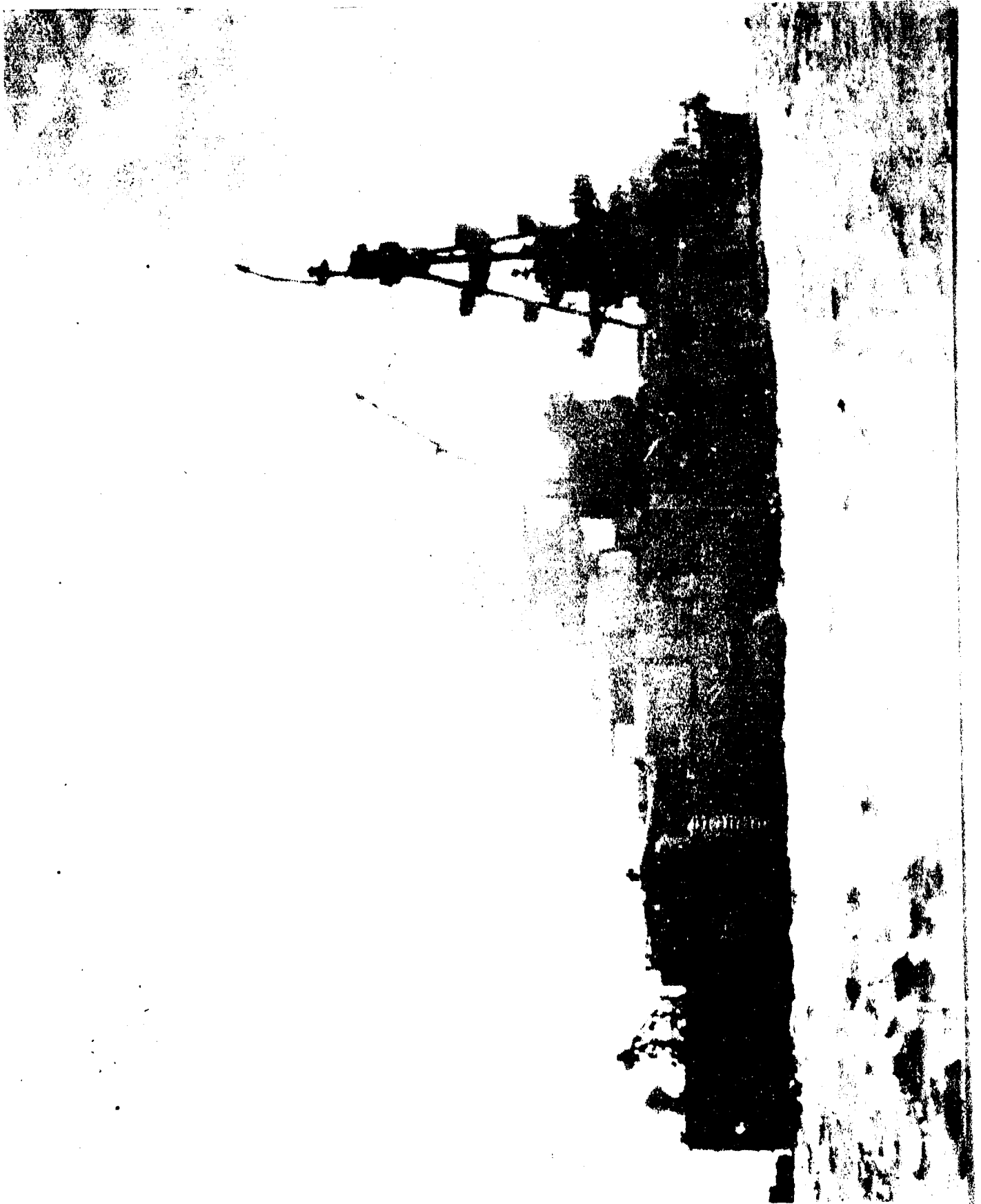
Page 166 of 211 Pages



AA-CR-227-50-116. U.S.S. SALT LAKE CITY (CA25). View looking at port bow after Test A.

TOP SECRET

Page 167 of 211 Pages



AA-CR-227-91-46. U.S.S. SALT LAKE CITY (CA25). View looking at port quarter after Test A.

TOP SECRET

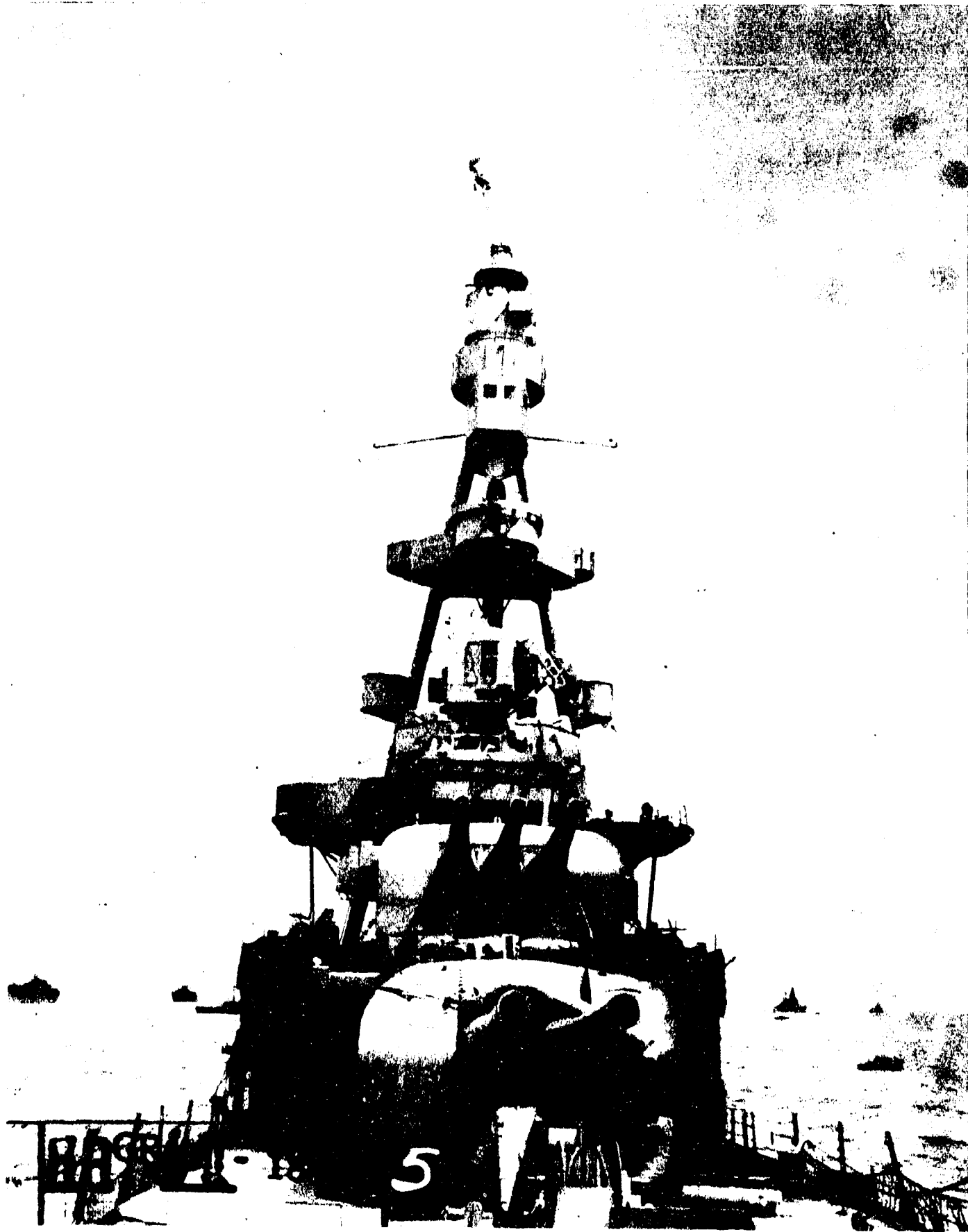
Page 168 of 211 Pages



AA-CR-227-91-47. U.S.S. SALT LAKE CITY (CA25). View looking at starboard beam after Test A.

TOP SECRET

Page 169 of 211 Pages



AA-CR-62-1861-5. U.S.S. SALT LAKE CITY (CA25). View looking at forward superstructure from bow. Note curve in "SG" radar polemast.

TOP SECRET

Page 170 of 211 Pages



AA-CR-62-1869-5. U.S.S. SALT LAKE CITY (CA25). Looking forward at top of forward tripod and radar polemast from frame 74.

TOP SECRET

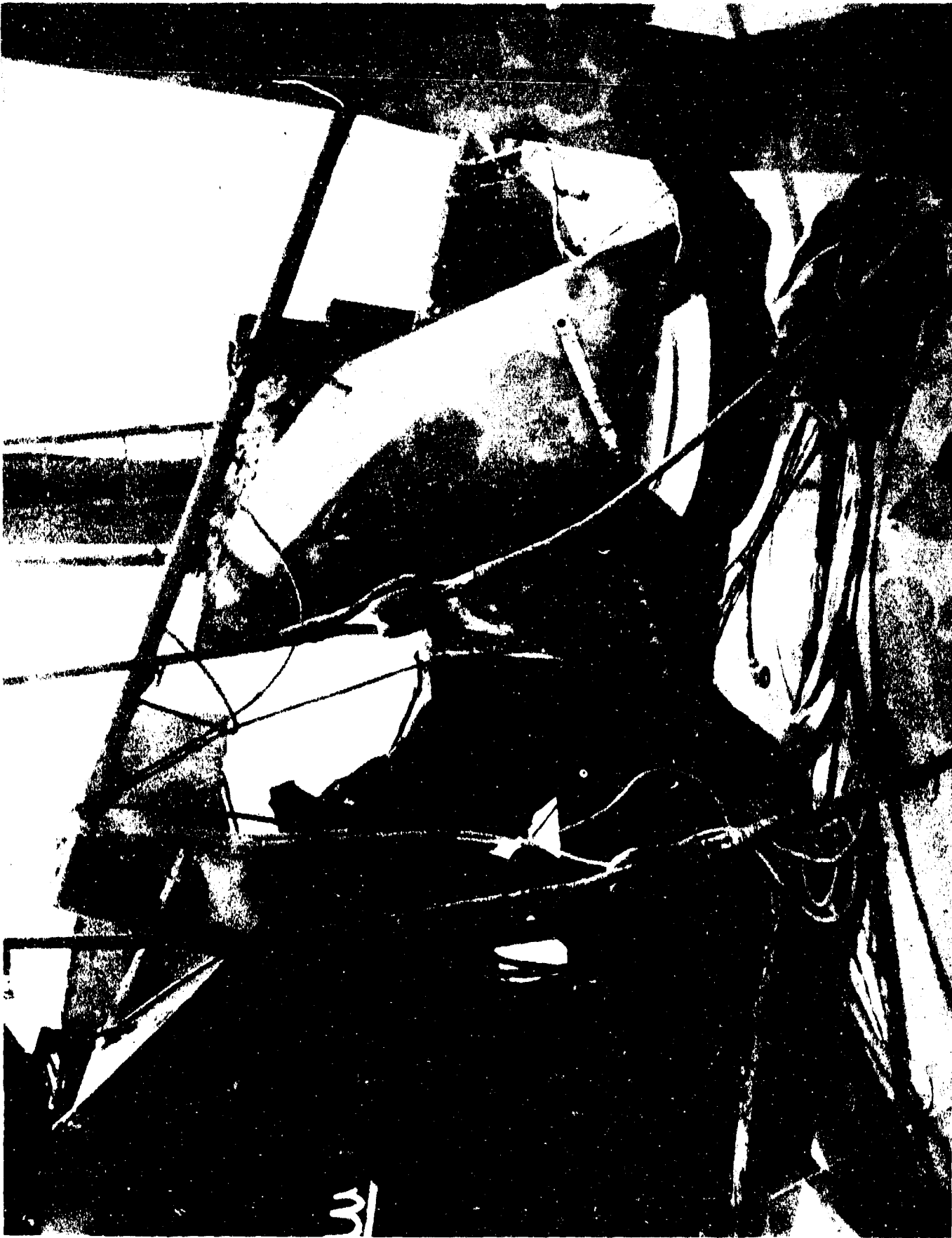
Page 171 of 211 Pages



AA-CR-62-1869-6. U.S.S. SALT LAKE CITY (CA25). View showing effect of blast on TBM radio whip antennae.

TOP SECRET

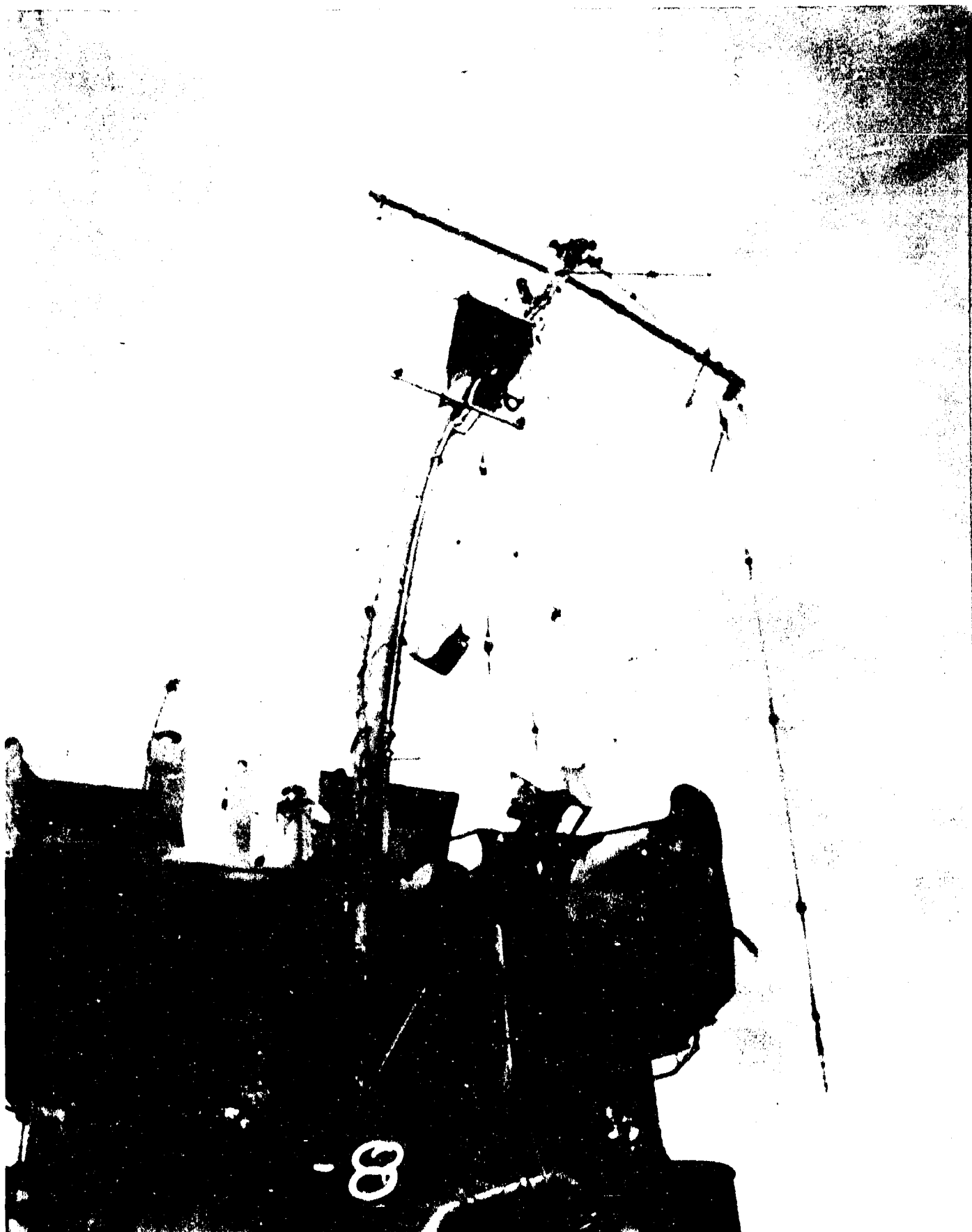
Page 172 of 211 Pages



AA-CR-62-1869-3. U.S.S. SALT LAKE CITY (CA25). View of port side navigating bridge level.

TOP SECRET

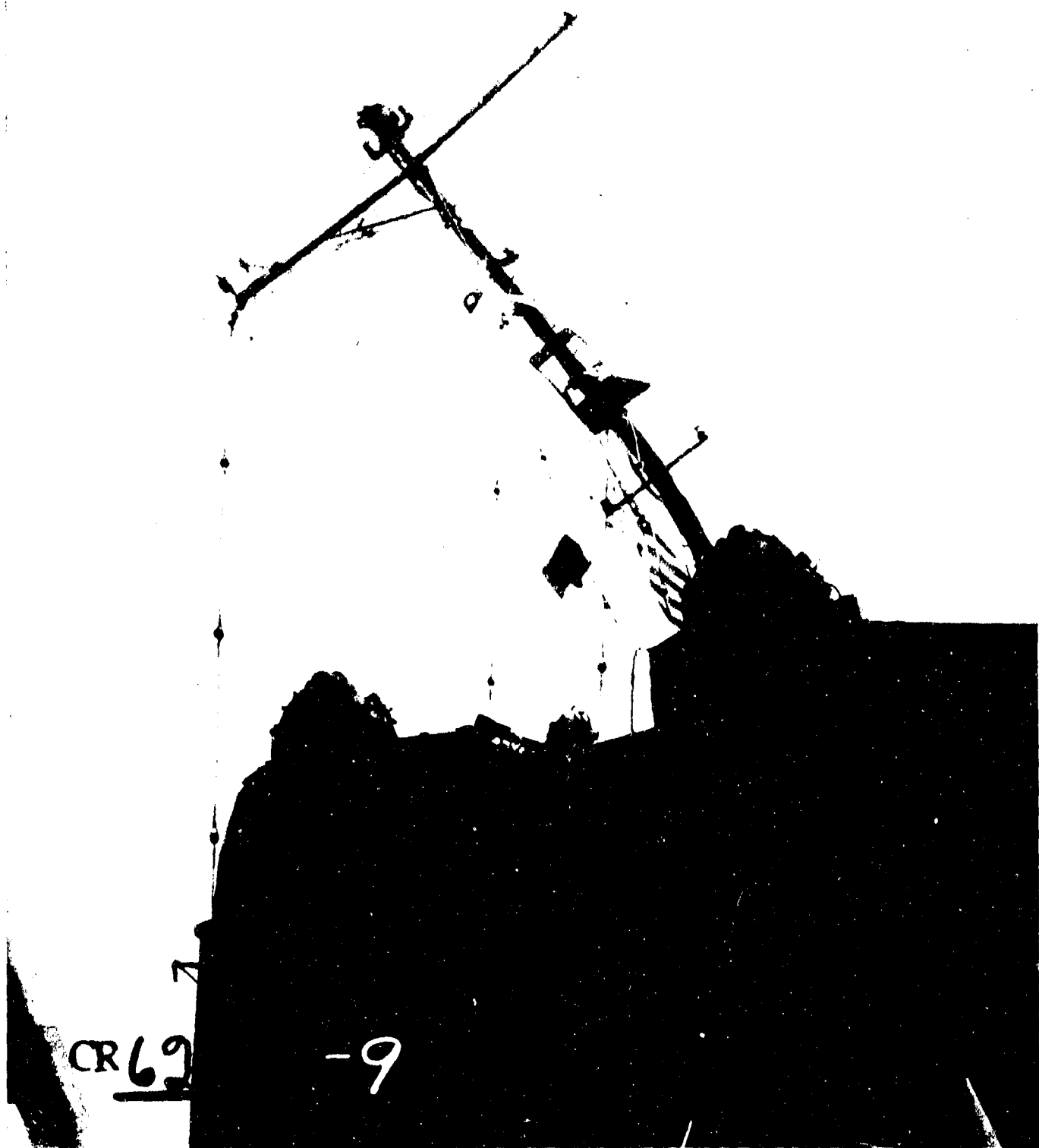
Page 173 of 211 Pages



AA-CR-62-1868-8. U.S.S. SALT LAKE CITY (CA25). View looking forward at bulkhead 83 from frame 94 showing curve in mast and condition of rigging.

TOP SECRET

Page 174 of 211 Pages



AA-CR-62-1868-9. U.S.S. SALT LAKE CITY (CA25). Looking aft at superstructure bulkhead 84 from 01 deck level.

TOP SECRET

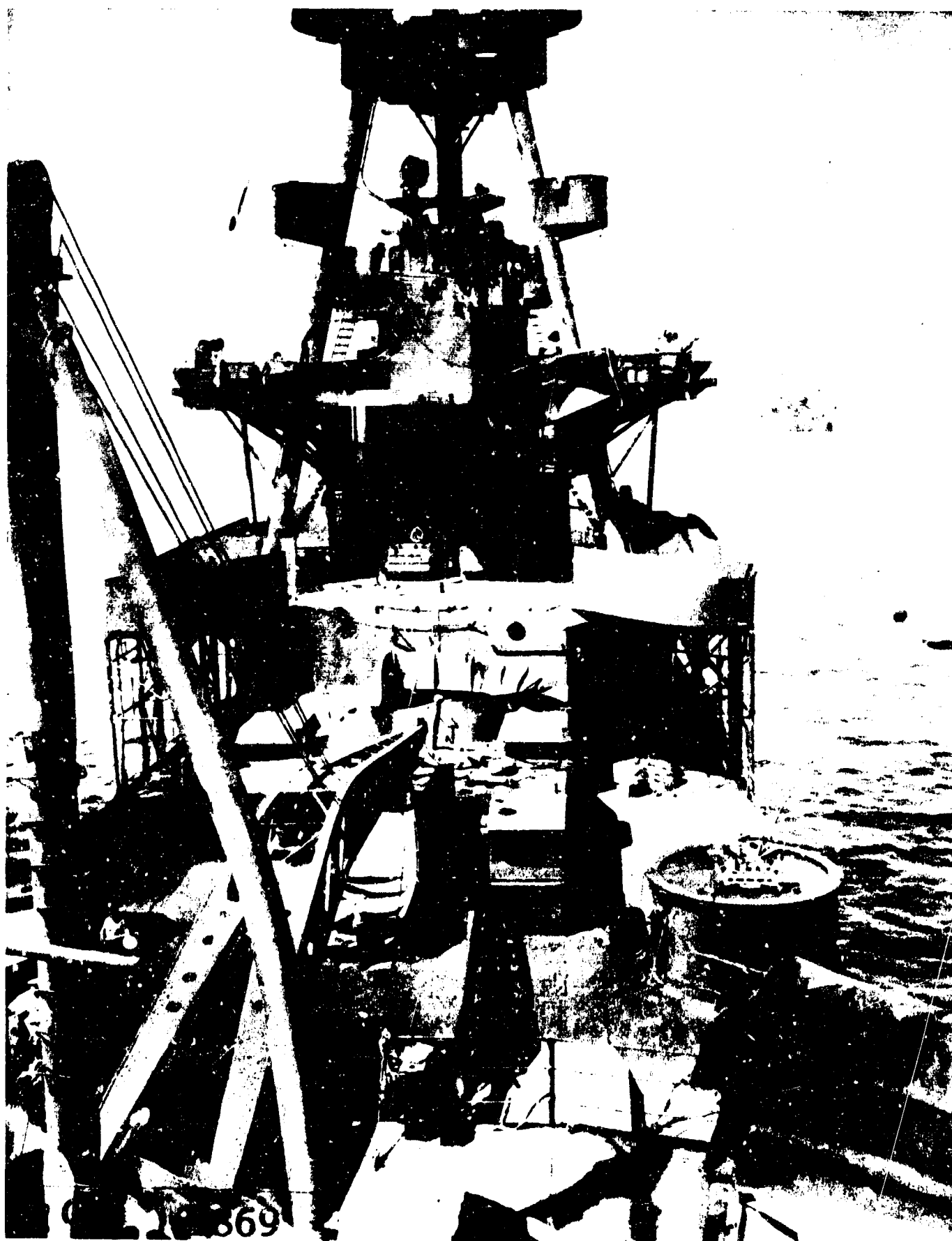
Page 175 of 211 Pages



AA-CR-62-1868-11. U.S.S. SALT LAKE CITY (CA25). Looking at #2 smoke stack against starboard leg of airplane boom tripod. Looking aft from frame 72.

TOP SECRET

Page 176 of 211 Pages



AA-CR-62-1869-4. U.S.S. SALT LAKE CITY (CA25). Looking at forward tripod from frame 74.

TOP SECRET

Page 177 of 211 Pages



AA-CR-62-1868-10. U.S.S. SALT LAKE CITY (CA25). Looking at port side of No. 2 smoke stack stump. Note loose end of rigging upper center right. Note also bend in starboard tripod leg caused by smokestack in falling.

TOP SECRET

Page 178 of 211 Pages



BB-CR-227-513-11. U.S.S. HUGHES (DD410). View looking at starboard beam after Test Able.

TOP SECRET

Page 179 of 211 Pages



BuShips #114020. U.S.S. HUGHES (DD410). View looking at port beam before Test Able.

TOP SECRET

Page 180 of 211 Pages



AA-CR-100-2198-4. U.S.S. HUGHES (DD410). View looking to starboard and up at foremast.

TOP SECRET

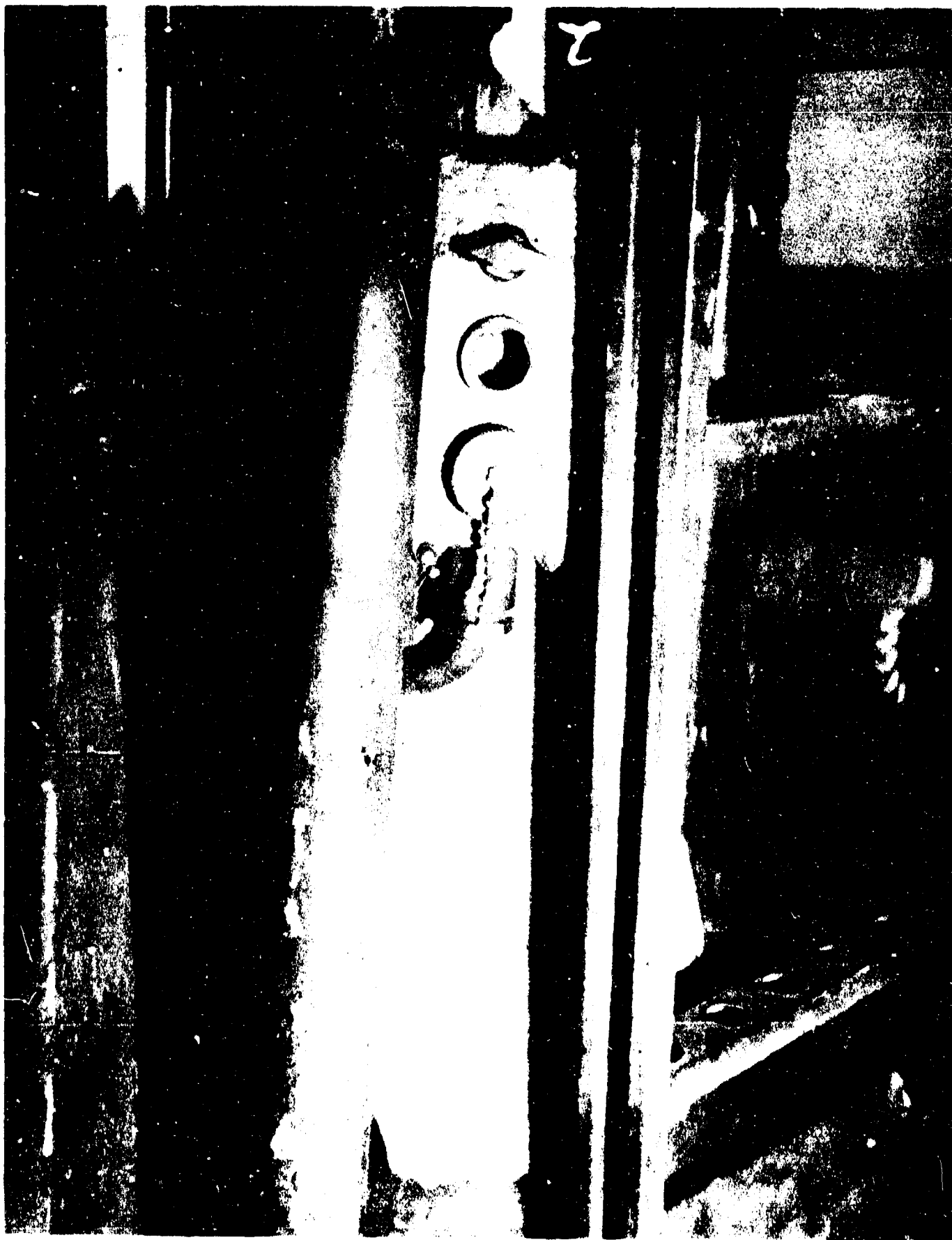
Page 181 of 211 Pages



AA-CR-100_2198-3. U.S.S. HUGHES (DD410). Detail - after side of foremast.

TOP SECRET

Page 182 of 211 Pages



AA-CR-100-2198-2. U.S.S. HUGHES (DD410). Detail - forward side of foremast.

TOP SECRET

Page 183 of 211 Pages



BA-CR-196-156-1. U.S.S. RHIND (DD404). View looking at port bow before Test Able.

TOP SECRET

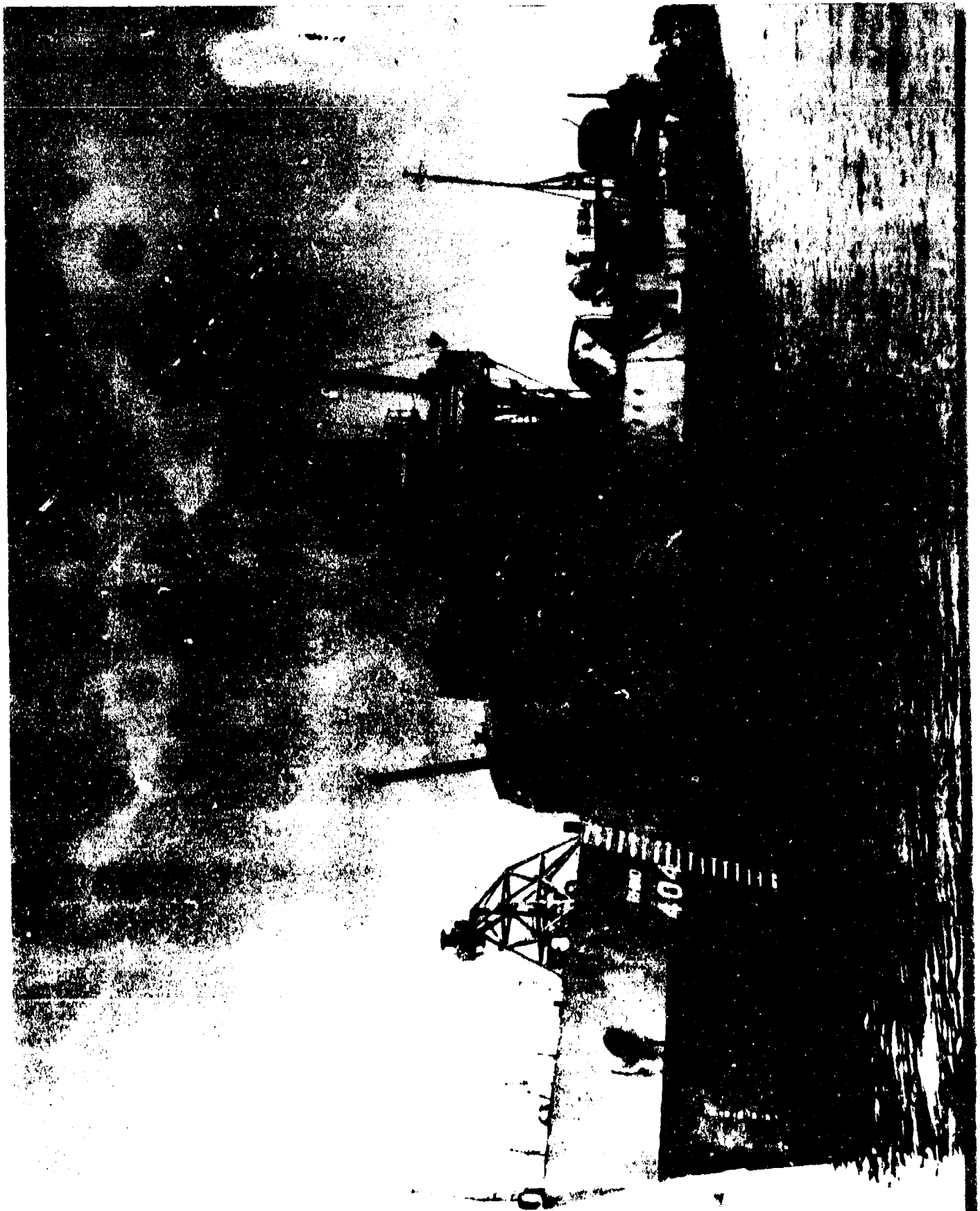
Page 184 of 211 Pages



AA-CR-227-49-137. U.S.S. RHIND (DD404). View looking at port bow after Test Able.

TOP SECRET

Page 185 of 211 Pages



AB-CR-227-283-58. U.S.S. RHIND (DD404). View looking at port bow after Test Baker.

TOP SECRET

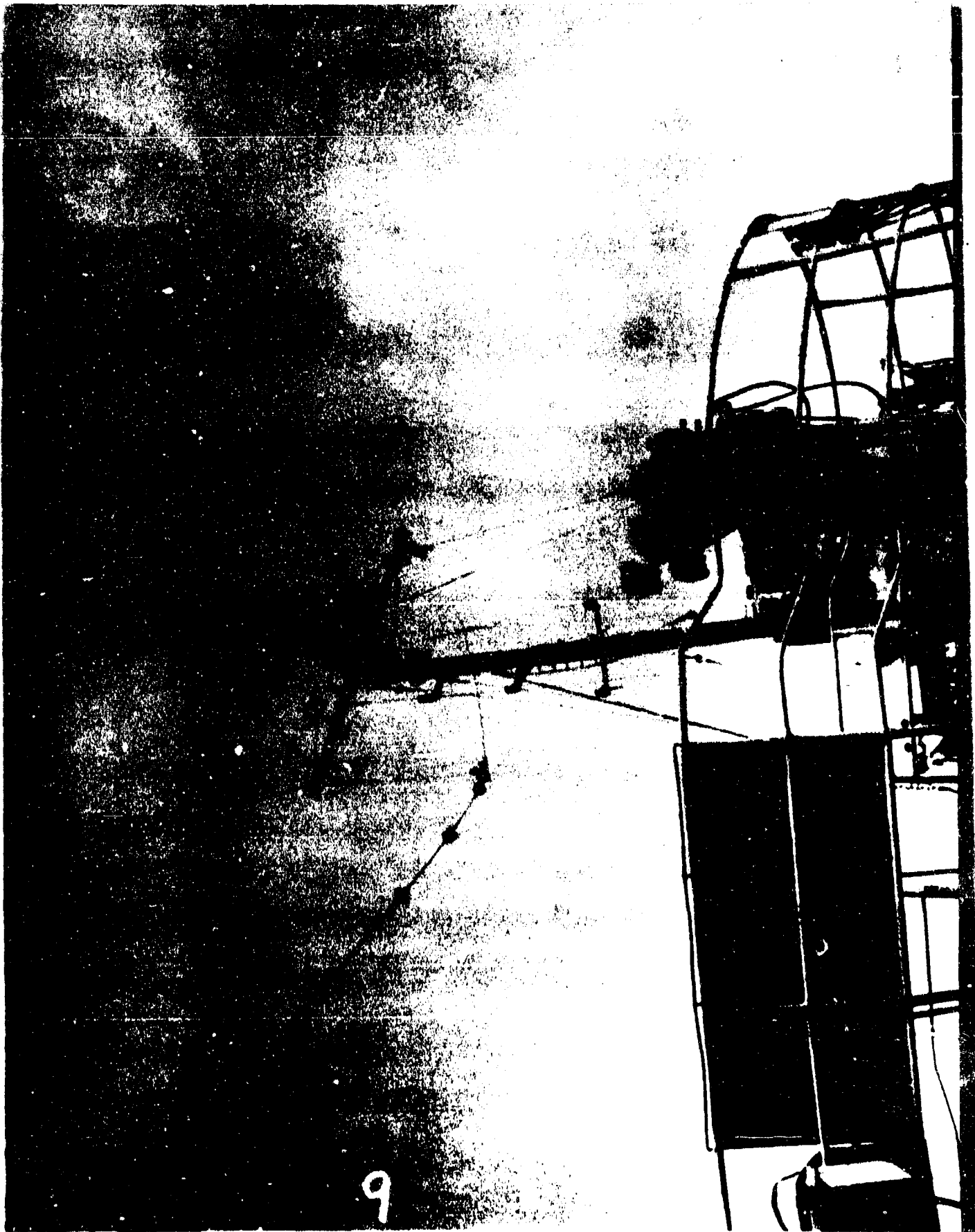
Page 186 of 211 Pages



BB-CR-227-520-42. U.S.S. RHIND (DD404). View looking at starboard quarter, after Test A.

TOP SECRET

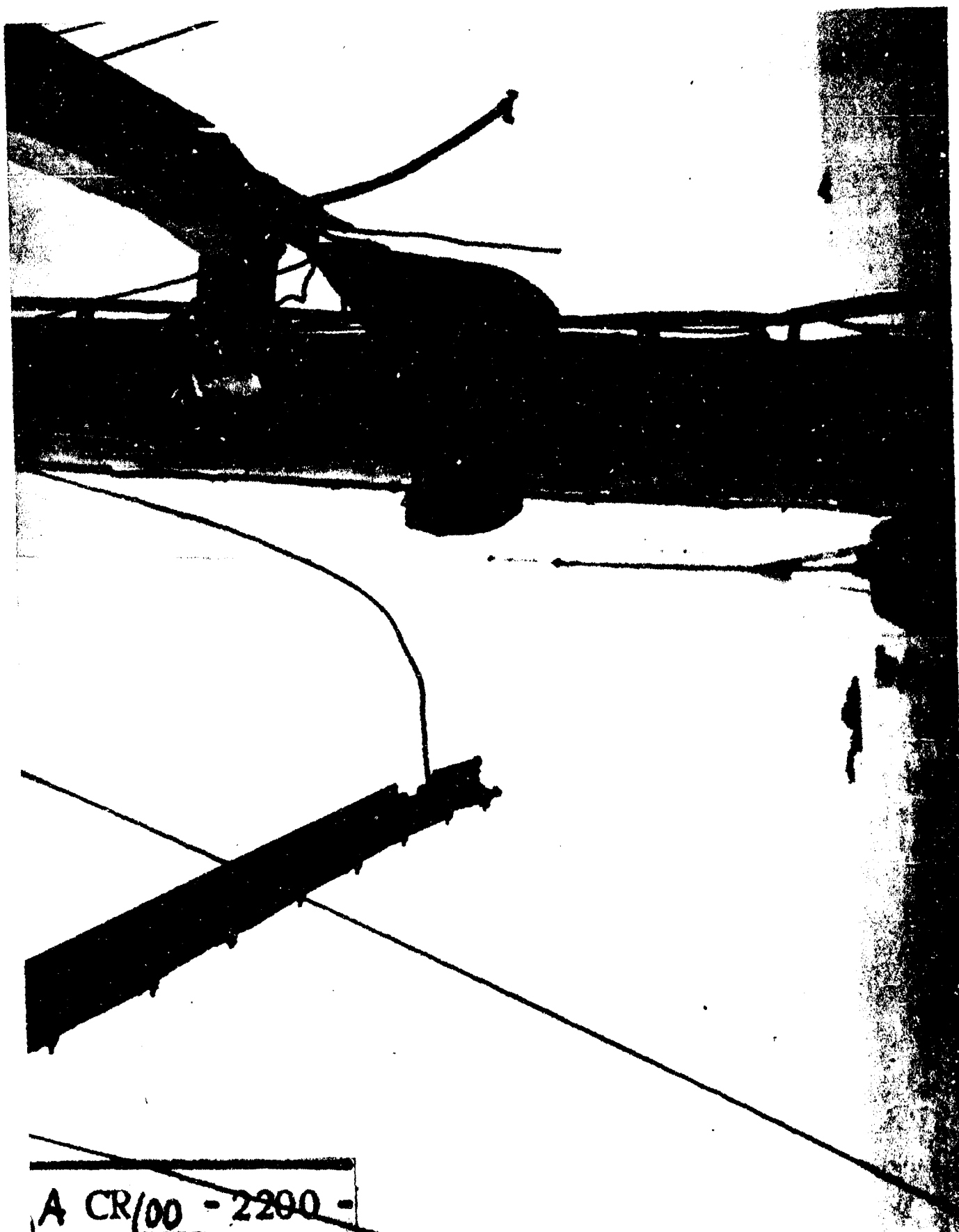
Page 187 of 211 Pages



AA-CR-100-2200-9. U.S.S. RHIND (DD404). Foremast from frame 133.

TOP SECRET

Page 188 of 211 Pages

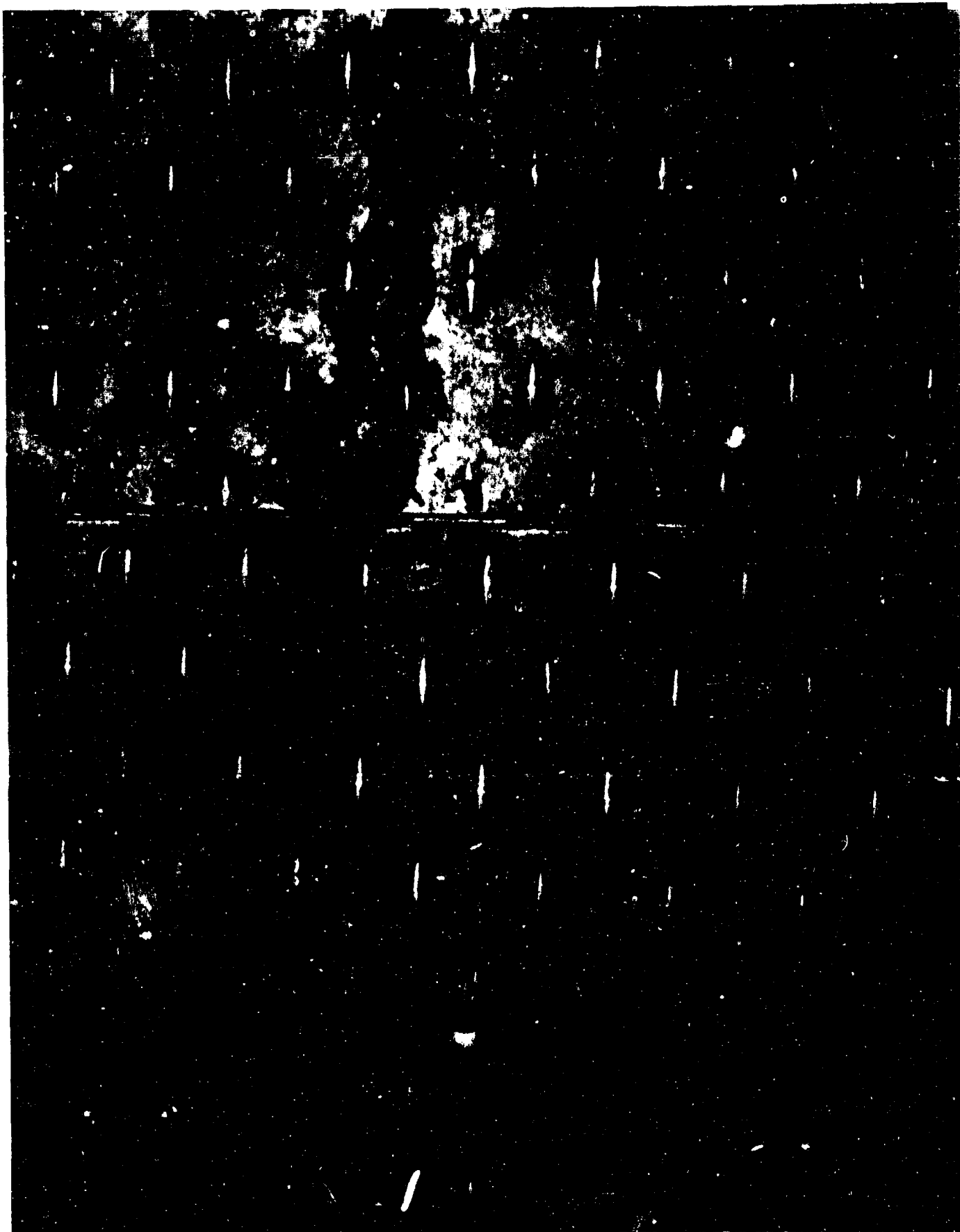


A CR/00 - 2290 -

AA-CR-100-2200-2. U.S.S. RHIND (DD404). Break in port and starboard cable shields on foremast.

TOP SECRET

Page 189 of 211 Pages



AA-CR-100-2200-1. U.S.S. RHIND (DD404). Frayed end of lower starboard forward gut of foremast.

TOP SECRET

Page 190 of 211 Pages



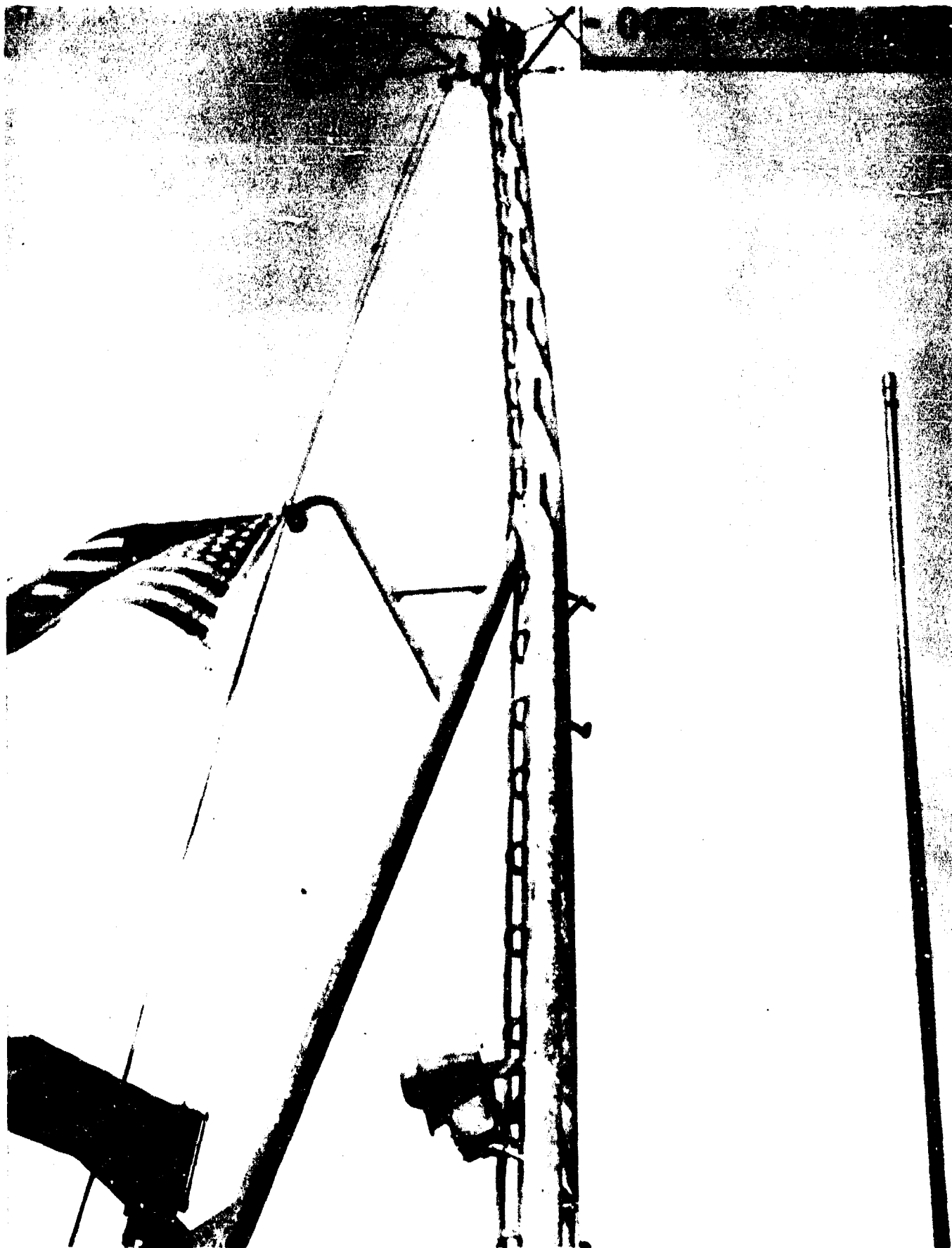
AA-CR-100-2200-7. U.S.S. RHIND (DD404). Base of after strut to after tripod.

TOP SECRET

Page 191 of 211 Pages



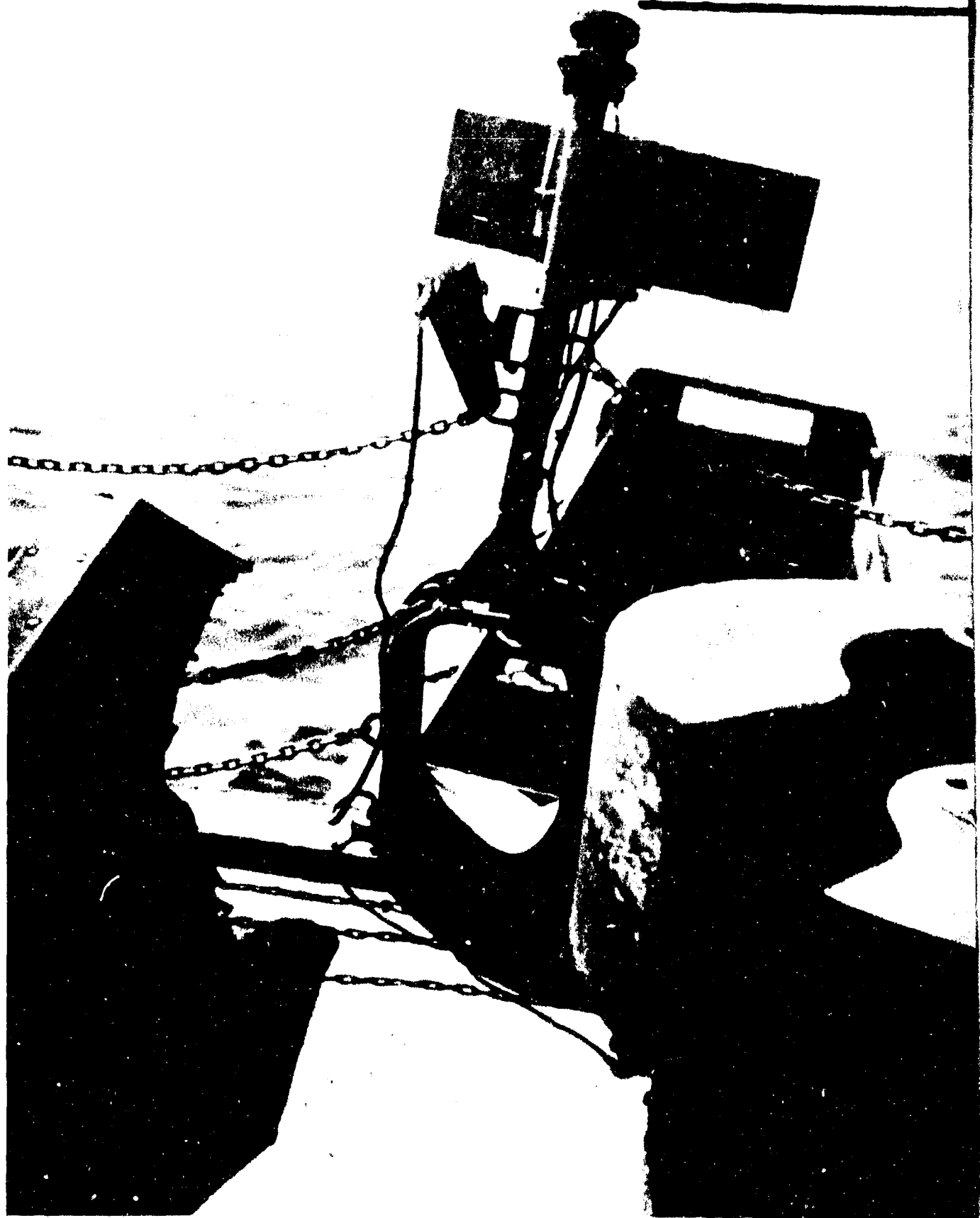
AA-CR-100-2200-8. U.S.S. RHIND (DD404). Mainmast and braces. Paint cracks are visible just above junction of braces.



AA-CR-100-2200-10. U.S.S. RHIND (DD404). View of mainmast looking to port.

TOP SECRET

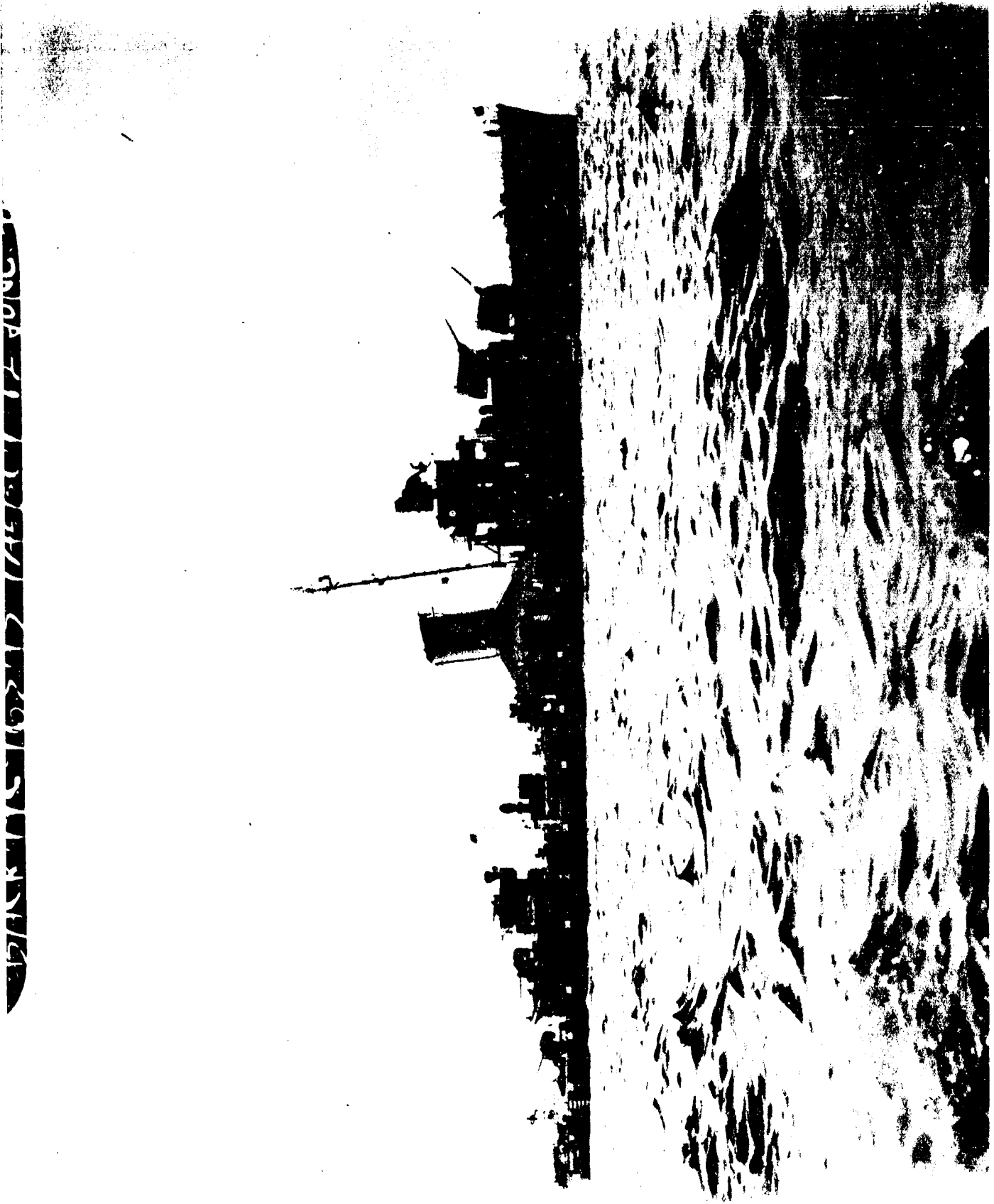
Page 193 of 211 Pages



AA-CR-100-2200-11. U.S.S. RHIND (DD404). Sternlight pole.

TOP SECRET

Page 194 of 211 Pages



BA-CR-196-163-13. U.S.S. RALPH TALBOT (DD390). Starboard beam - Before Test Able.

TOP SECRET

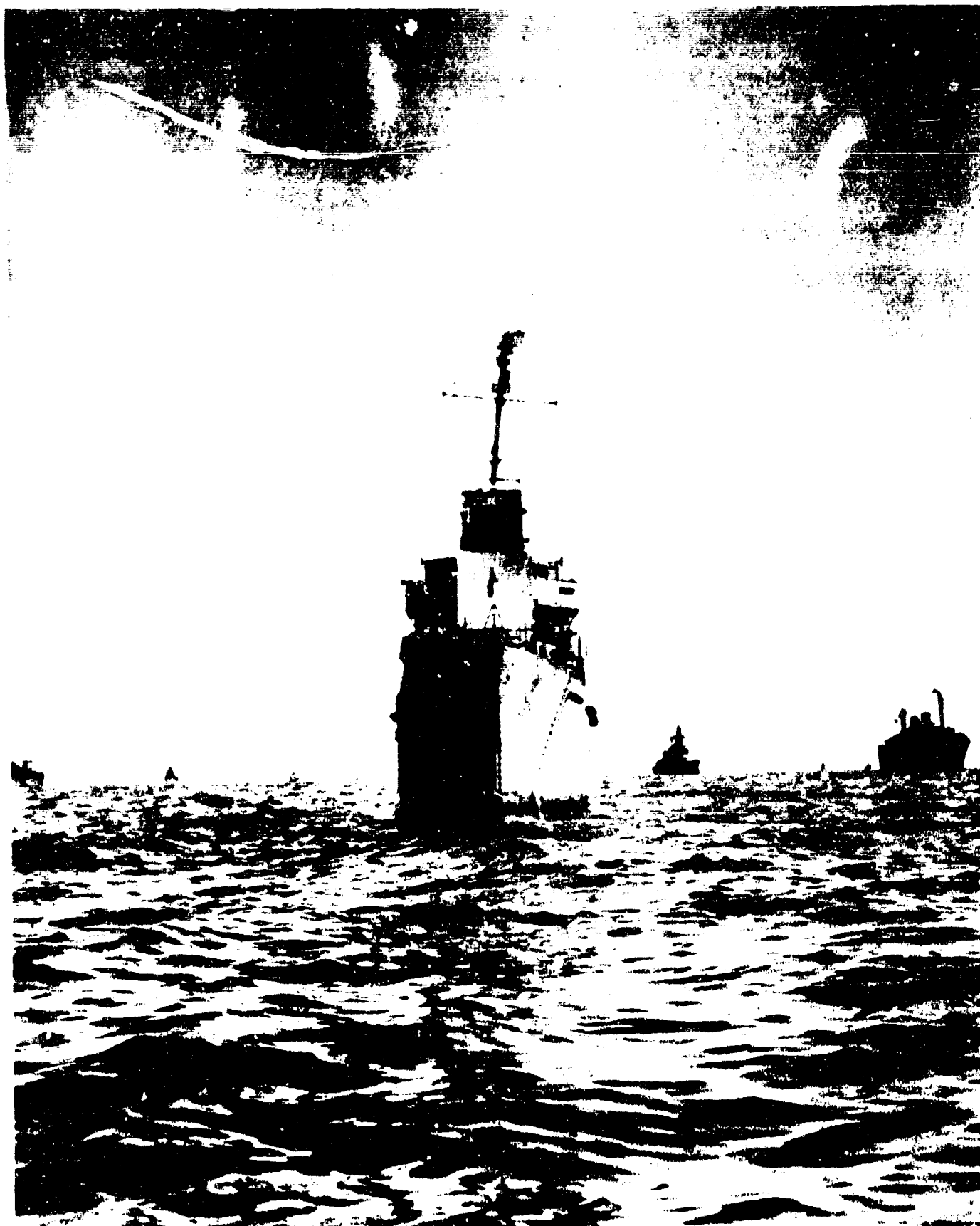
Page 195 of 211 Pages



BA-CR-196-163-15. U.S.S. RALPH TALBOT (DD 390) Bow before Test Able.

TOP SECRET

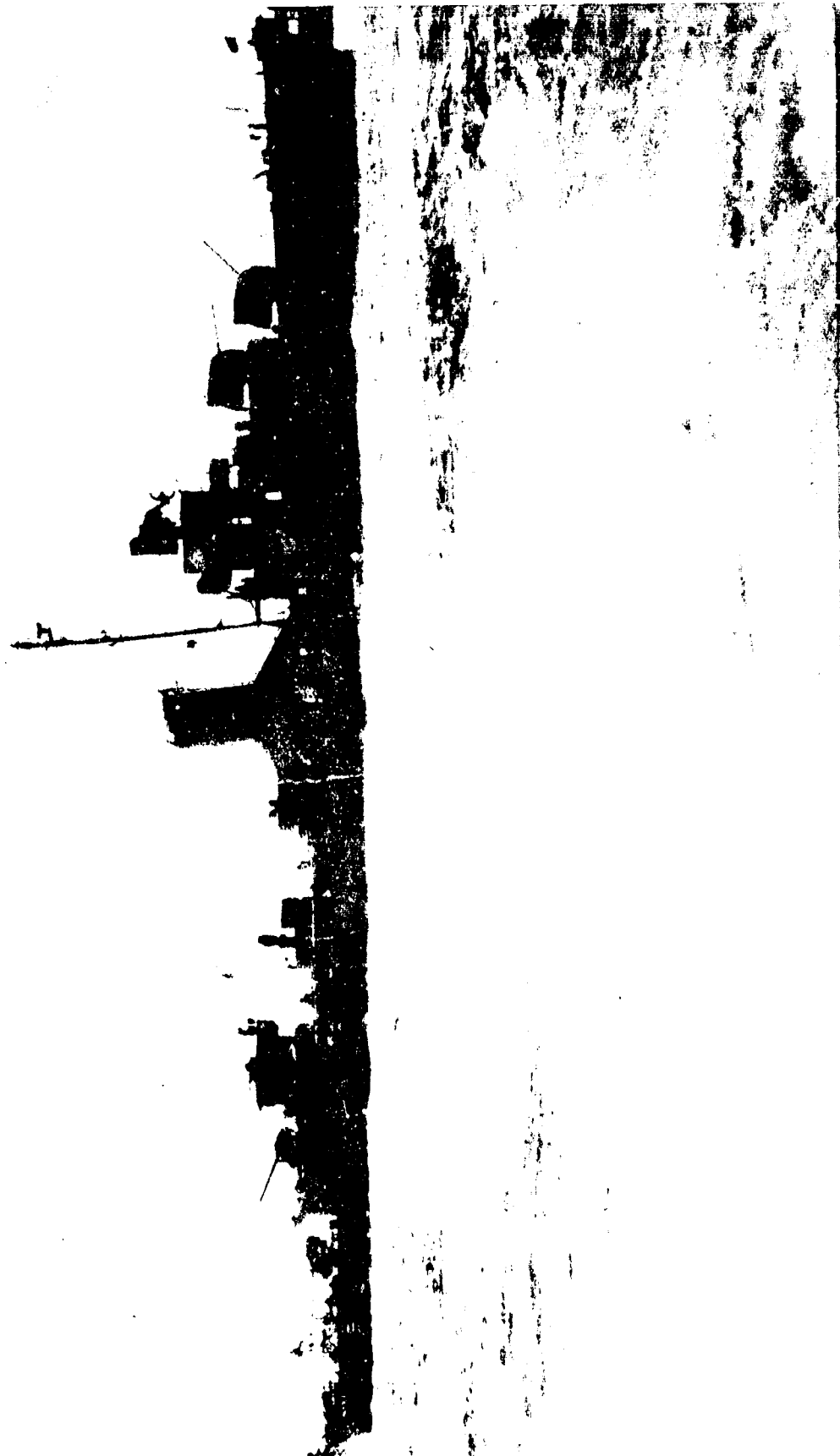
Page 196 of 211 Pages



AB-CR-227-513-46. U.S.S. RALPH TALBOT; (DD390). Bow - Before
Test Baker.

TOP SECRET

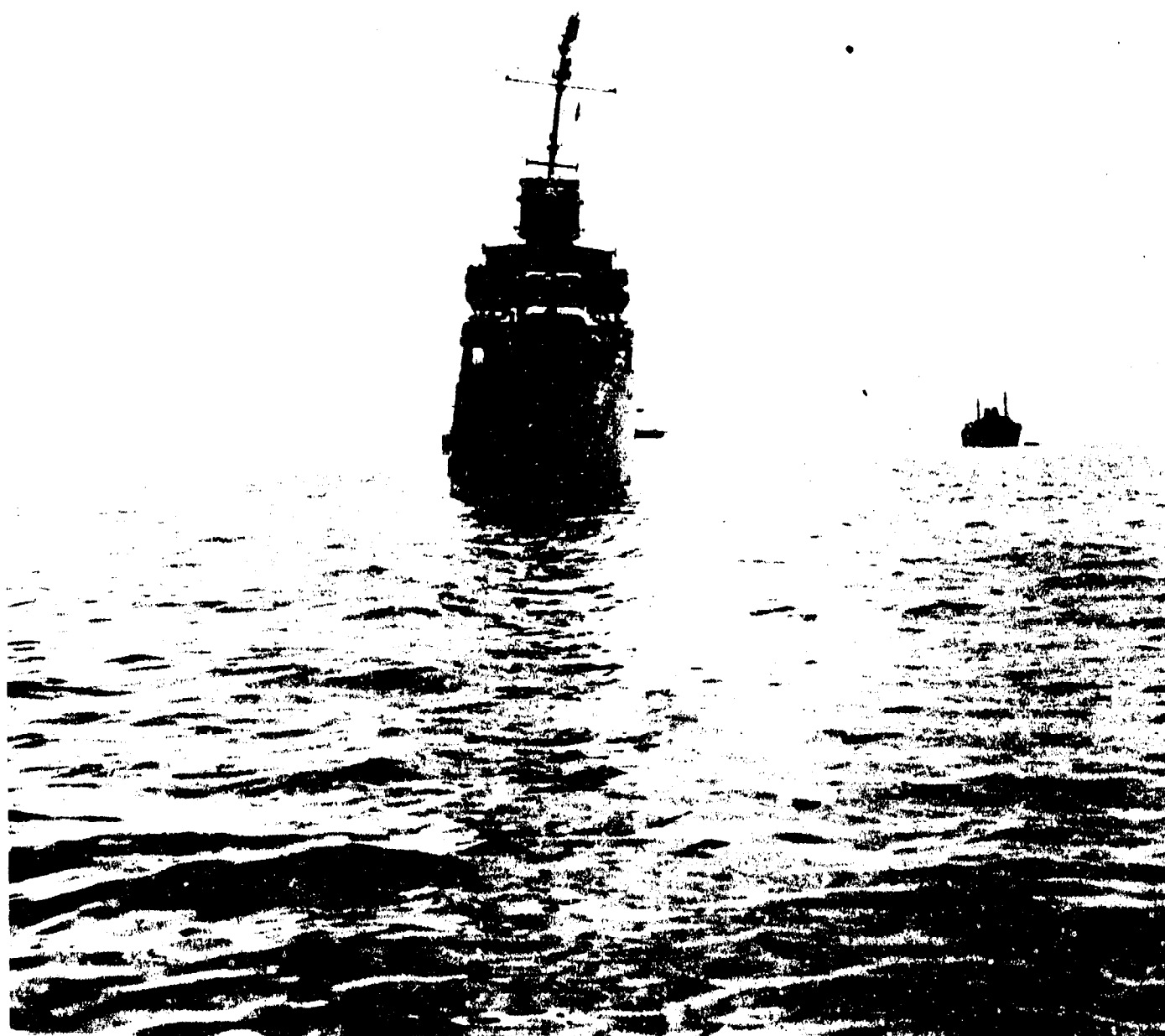
Page 197 of 211 Pages



BB-CR-227-513-48. U.S.S. RALPH TALBOT (DD390). Starboard beam -
Before Test Baker.

TOP SECRET

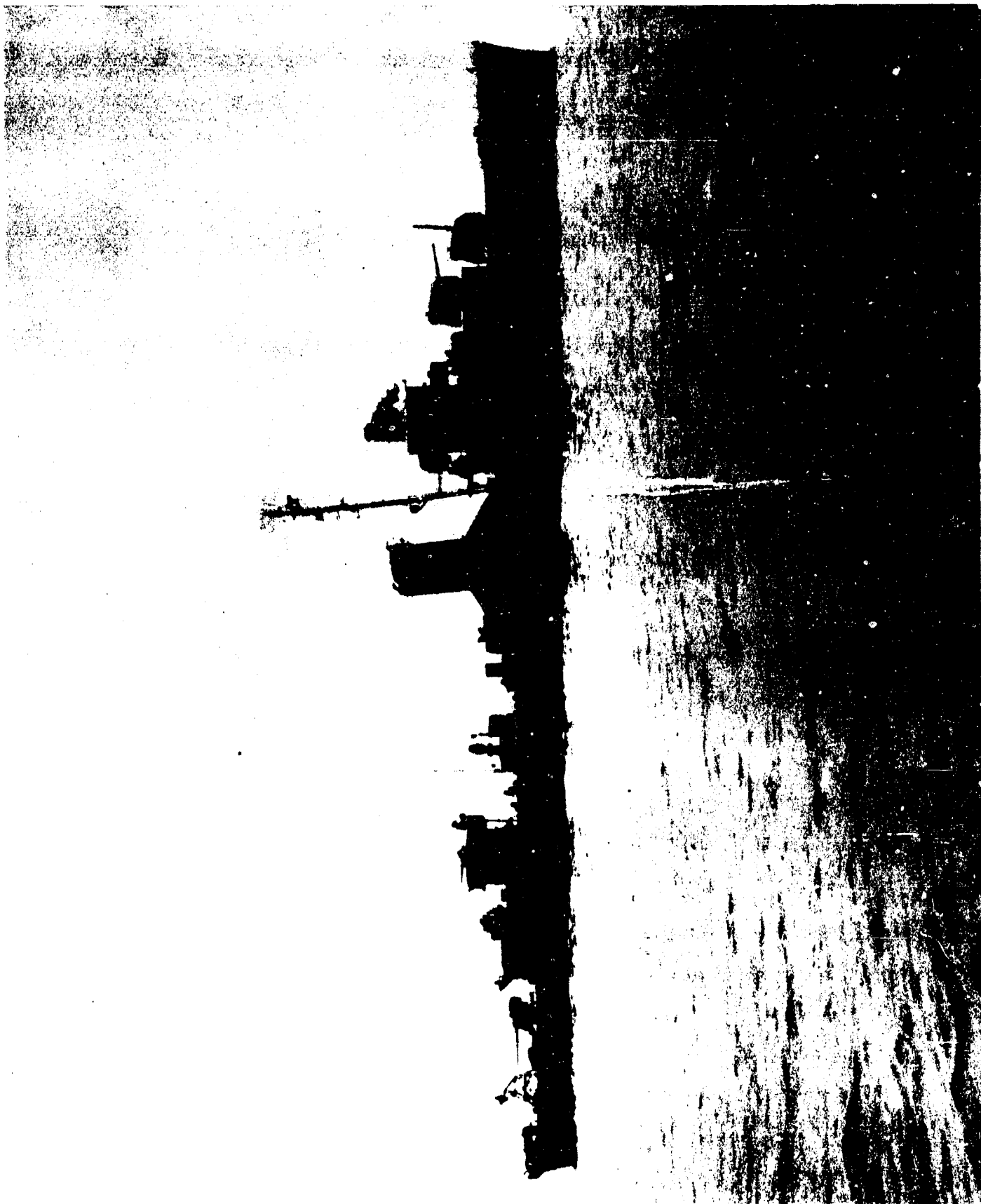
Page 198 of 211 Pages



AB-CR-227-243-22. U.S.S. RALPH TALBOT (DD390). Bow - after
Test Baker.

TOP SECRET

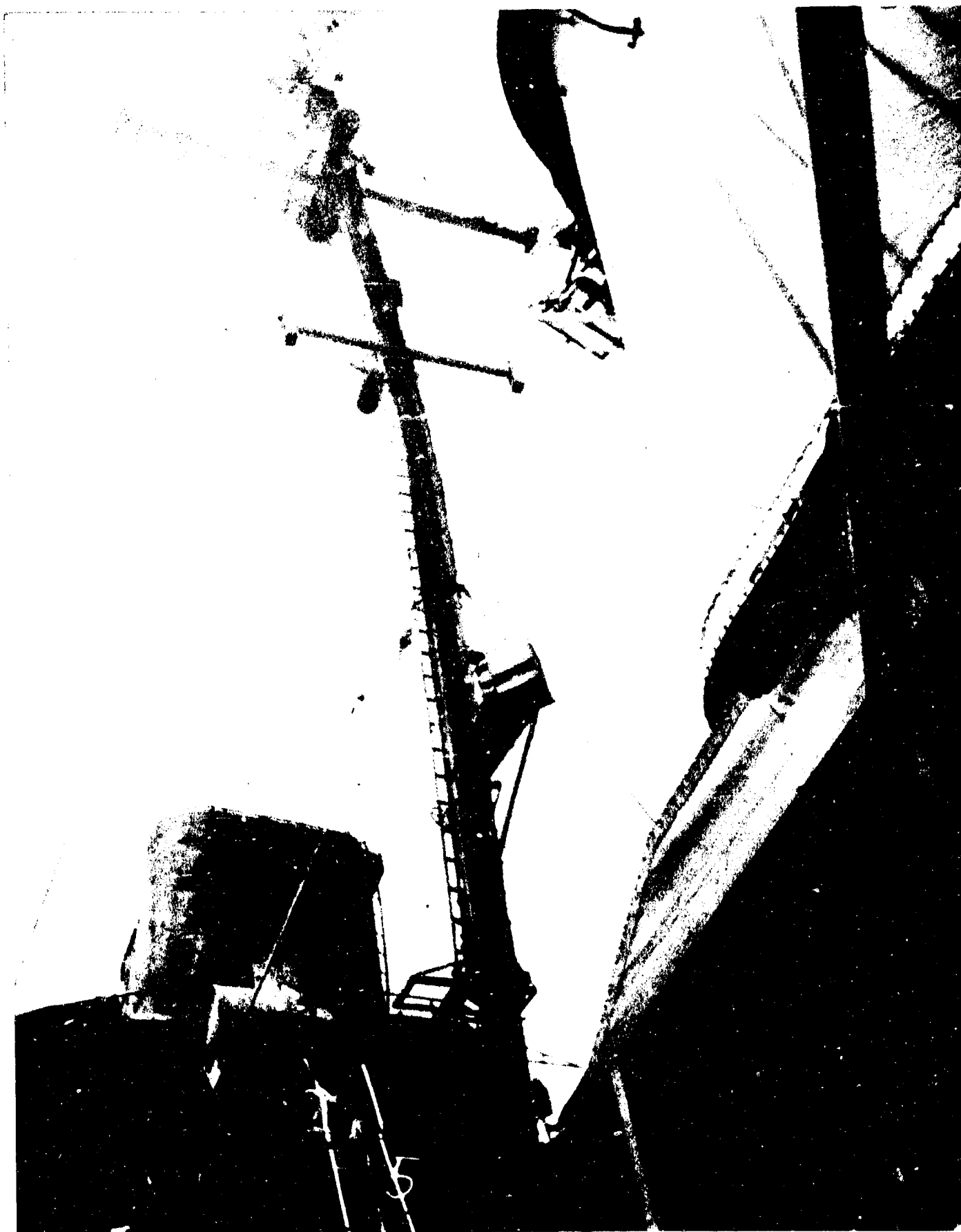
Page 199 of 211 Pages



AB-CR-227-243-24. U.S.S. RALPH TALBOT (DD390). Starboard beam after Test Baker.

TOP SECRET

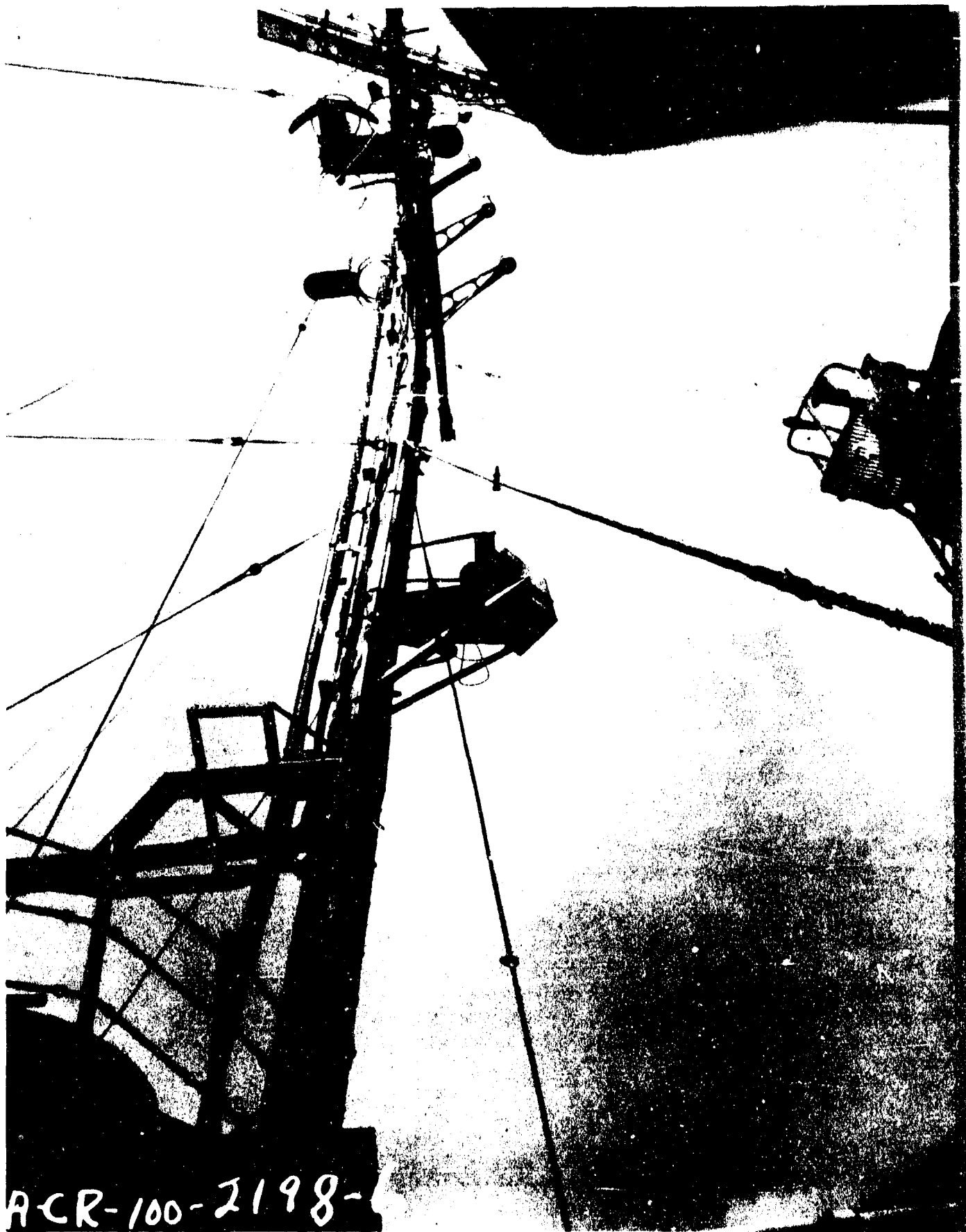
Page 200 of 211 Pages



AA-CR-100-2198-5. U.S.S. RALPH TALBOT (DD390). View looking forward and up at foremast from port side.

TOP SECRET

Page 201 of 211 Pages

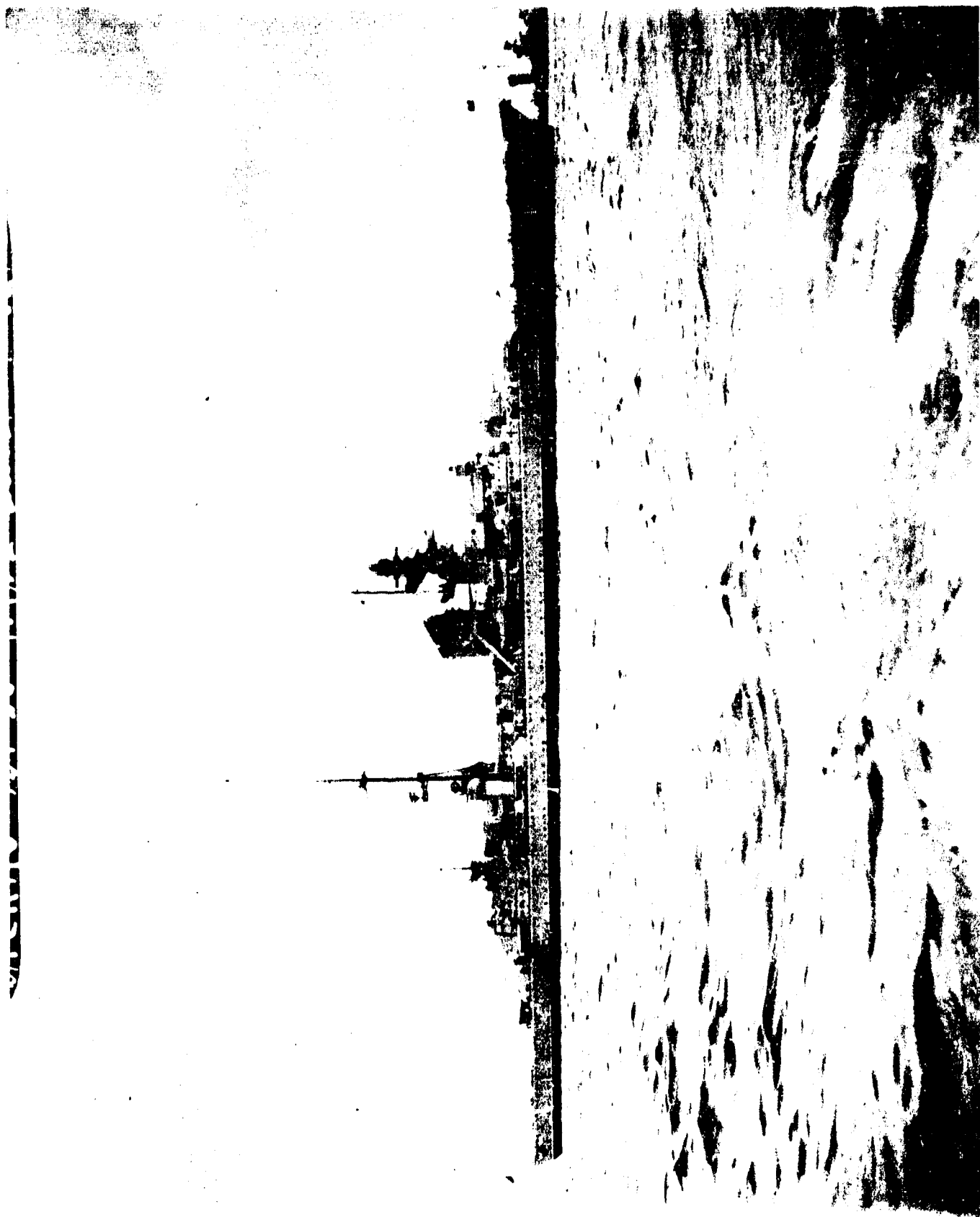


AA-CR-100-2198-6

AA-CR-100-2198-6. U.S.S. RALPH TALBOT (DD390). View looking up foremast from port side.

TOP SECRET

Page 202 of 211 Pages



BA-CR-196-157-38. PRINZ EUGEN (IX300). View looking at starboard beam before Test Able.

TOP SECRET

Page 203 of 211 Pages



AA-CR-227-92-101. PRINZ EUGEN (IX300). View looking at starboard beam after Test Able. Note that main topmast has been broken off.

TOP SECRET

Page 204 of 211 Pages



AA-CR-100-2199-2. PRINZ EUGEN (IX300). Damage to wood torymast by Test Able. Taken on 09 level, looking to starboard.

TOP SECRET

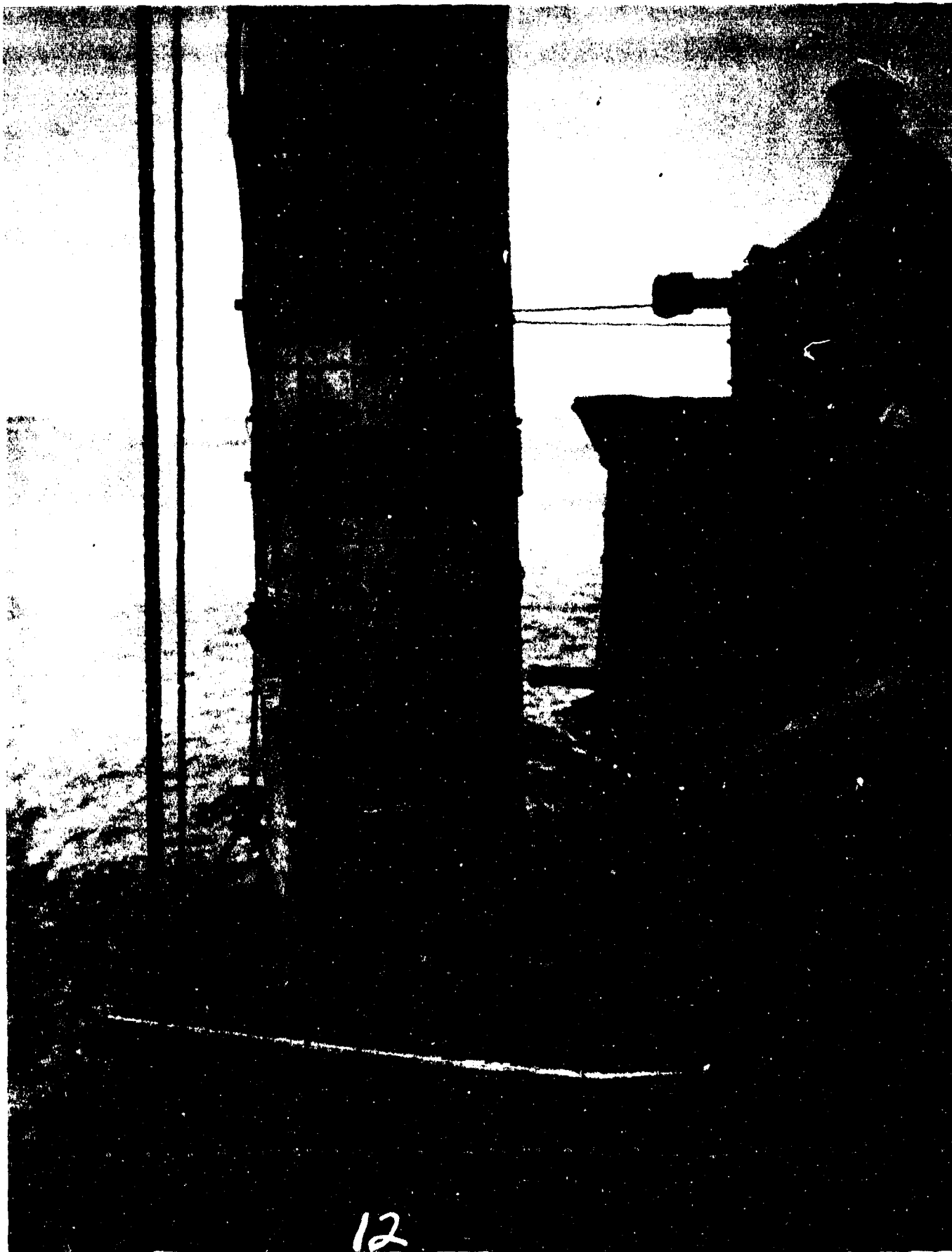
Page 205 of 211 Pages



AA-CR-100-2199-3. PRINZ EUGEN (IX300). Continuation of crack shown in 2199-2.

TOP SECRET

Page 206 of 211 Pages



AA-CR-100-2200-12. PRINZ EUGEN (IX300). Damage to wood foretopmast by Test Able. Taken on 09 level, looking to port. Note temporary repairs.

TOP SECRET

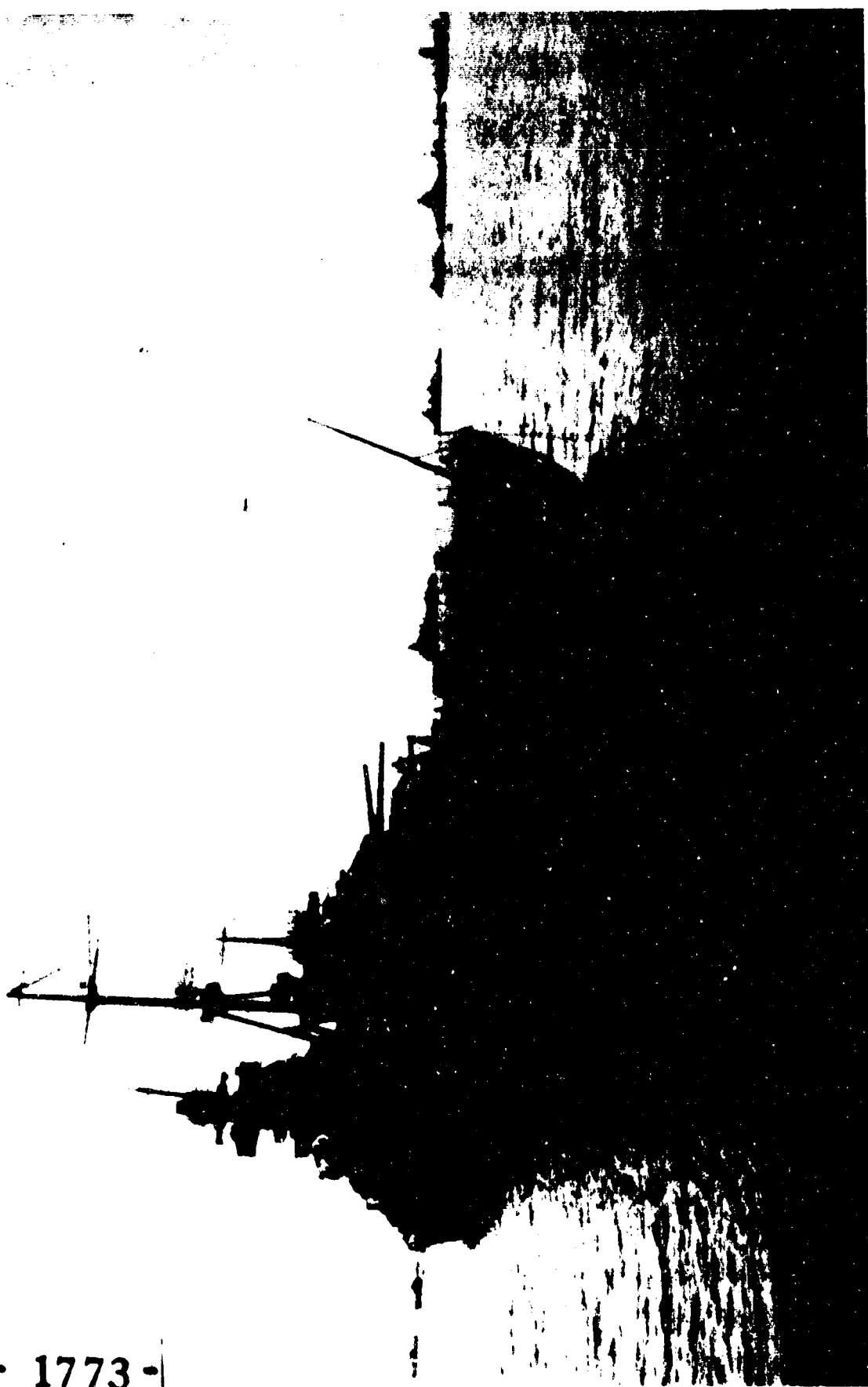
Page 207 of 211 Pages



AA-CR-100-2199-1. PRINZ EUGEN (IX300). Continuation of crack shown in 2200-12.

TOP SECRET

Page 208 of 211 Pages



AA-CR-92-1773-7

AA-CR-92-1773-7. PRINZ EUGEN (IX300). View looking at port after quarter showing main topmast hanging after Able.

TOP SECRET

Page 209 of 211 Pages



AA CR 92-1773-

AA-CR-92-1773-8. PRINZ EUGEN (IX300). View looking at port beam showing crack in foretopmast after Test Able.

TOP SECRET

Page 210 of 211 Pages



AA-CR-92-1774-5. PRINZ EUGEN (IX300). Broken mast, looking up,
after Test Able.

CONFIDENTIAL



Defense Special Weapons Agency
6801 Telegraph Road
Alexandria, Virginia 22310-3398

TRC

4 April 1997

MEMORANDUM TO DEFENSE TECHNICAL INFORMATION CENTER
ATTN: OMI/Mr Bill Bush

SUBJECT: Declassification of Documents

The following is a list of documents that have been declassified and the distribution statement changed to Statement A, Approved for Public Release.

XRD-41, AD-366731-
XRD-42, AD-366732-
XRD-40, AD-366730-
XRD-39, AD-366729-
XRD-38, AD-366728-
XRD-34, AD-366720-
XRD-13, AD-366725-
XRD-8, AD-366699-
XRD-5, AD-366697-
XRD-6, AD-366698-
XRD-21, AD-366708-
XRD-27, AD-366714-
XRD-22, AD-366709-
XRD-26, AD-366713-
XRD-28, AD-366715-
XRD-29, AD-366727-
XRD-36, AD-366722-

If you have any questions, please call me at 703-325-1034.

Arndith Jarrett
ARDITH JARRETT
Chief, Technical Resource Center